EMBARRAS RIVER

ERMA

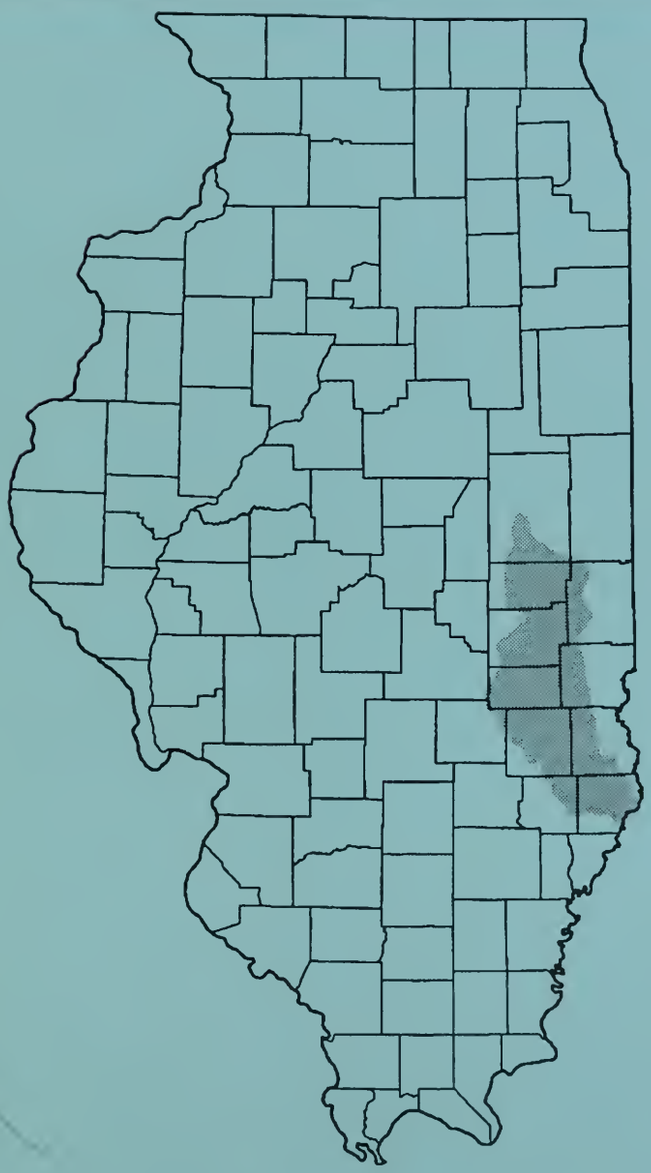
MANAGEMENT ASSOCIATION

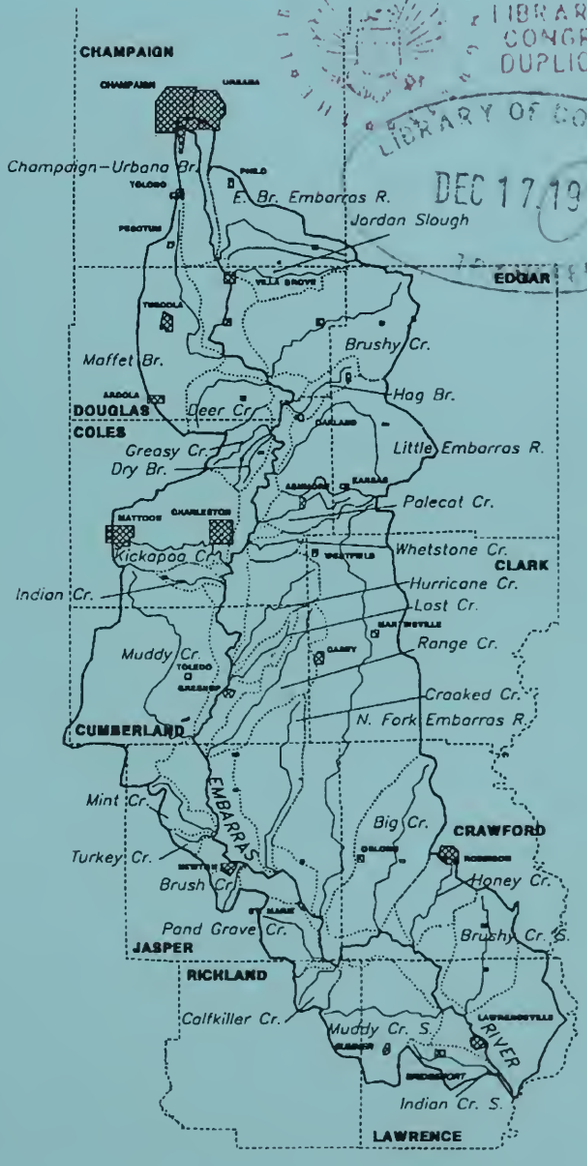
USDA

United States Department of Agriculture

Natural Resources Conservation Service

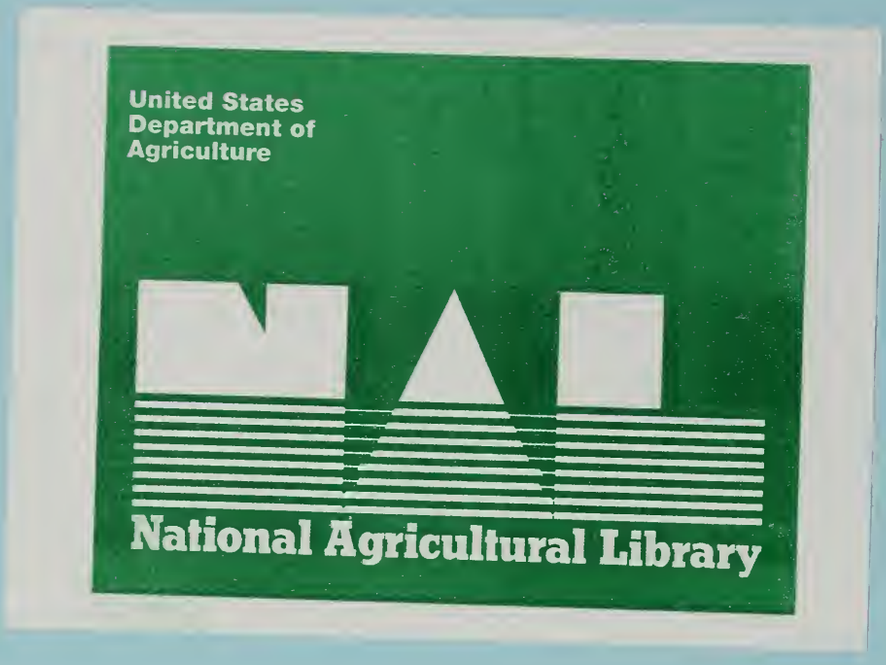
Champaign, Illinois





Embarras River Basin Resource Management Plan

October 1996



EMBARRAS RIVER BASIN REPORT

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SUMMARY
EMBARRAS RIVER BASIN

PROJECT: Embarras River Basin Resources Management Plan

STATE: Illinois

PREPARED BY: Embarras River Management Association (ERMA)
Natural Resources Conservation Service (NRCS)
Champaign County SWCD
Clark County SWCD
Coles County SWCD
Crawford County SWCD
Cumberland County SWCD
Douglas County SWCD
Edgar County SWCD
Jasper County SWCD
Lawrence County SWCD
Richland County SWCD
Upper Embarras Planning Committee
North Fork Conservancy District
Illinois Department of Natural Resources
Illinois Department of Agriculture
Illinois Environmental Protection Agency
US Fish and Wildlife Service
US Forest Service
University of IL, Cooperative Extension Service
Eastern IL University

DESCRIPTION OF RECOMMENDED PLAN

The recommended plan consists of a coordinated resource management plan for the Embarras river basin. This resource plan will:

- Promote/maintain the Embarras River's natural integrity
- Implement natural resource conservation planning
- Improve woodland management
- Identify, stabilize and restore wetlands
- Identify and implement streambank stabilization
- Create incentives for new practices

RESOURCE INFORMATION

Watershed size: 1,566,450 acres (2,440 sq. miles)

Land Use:

Cropland	77%
Forest land	11%
Grass land	4%
Rural transportation	3%
Urban land	2%
Water	1%
Miscellaneous	2%

Land Ownership: 97% Private 3% Public

Number of Farms: 4,140

Average Farm Size: 380 acres

Prime Farmland: 1,150,200 acres

Wetlands: 127,600 acres

Threatened and Endangered Species: 46 species identified in basin

Cultural Resources: Specific site reviews will determine if any cultural resources are impacted.

Locally Identified Resource Concerns:

1. Flooding
2. Log Jams/Obstructions
3. Water Quality
4. Erosion
5. Drainage
6. Beaver, Deer and Turkey related problems
7. Lack of Accountability-Communication
8. Loss of Natural Character
9. Private Property Rights
10. Sediment (sand deposits)
11. Bends in the Channel
12. Wetlands
13. Wildlife/Recreation Opportunities
14. Economic Costs (funding solutions)
15. Water Usage and Supply
16. Land Use Changes
17. Small Bridge Outlets
18. Lack of Education

PLAN PURPOSES

Improve drinking water quality.
Improve drinking water supply.
Reduce soil erosion on cropland, woodland, streambanks.
Provide flood control for communities and agricultural land.
Provide better fish and wildlife habitat.
Upgrade recreational activities and facilities.

ALTERNATIVES STUDIED

- No Action
- Purchase 10% of flooded cropland
- Build dams to control 30% of the basin
- Triple the amount of no-till cropland in the basin
- Identify sites and implement streambank stabilization
- Implement coordinated resource basin planning

The Coordinated Watershed Planning Alternative was selected as the best course of action to achieve ERMA goals.

ESTIMATED COSTS

		(% of Total Resource Needs)	
Category	**Cost**	**On-going Program**	**Implementation Rate**
Conservation Land Treatment Practices	$34,000,000	5%	80%
Water Quality Improvement	$15,000,000	5%	80%
Wetland, Wildlife, Threatened and Endangered Species	$10,000,000	5%	80%
Flood Damage Reduction Features	$13,000,000	0%	100%
Technical Support	$ 5,000,000	-	-
Mitigation	$ 5,000,000	-	-
Total Estimated Cost	**$82,000,000**		

The estimated cost for land treatment for erosion and sediment reduction ($34,000,000), water quality improvement ($15,000,000) and wetland, wildlife, threatened and endangered species ($10,000,000) accounts for 80% anticipated acceptance and implementation rate. Flood damage reduction features ($13,000,000) accounts for 100% structure construction. Technical support ($5,000,000) accounts for planning, design and implementation assistance needed from field office and staff specialists. Mitigation ($5,000,000) accounts for replacement of forest and natural area values that may be disturbed or destroyed during construction of dry dams. See the Avoidance, Minimization, and Mitigation section for additional information about mitigation.

All Illinois Natural Area Inventory (INAI) sites will be avoided during site planning and construction. Unavoidable impacts to natural areas will be minimized and mitigated in conformance with National Environmental Policy Act (NEPA) provisions. See the Avoidance, Minimization, and Mitigation section for additional information about mitigation

IMPACTS

Reduce flood damages 25% through implementation of conservation practices and land use changes.

Reduce erosion on 500,000 acres of cropland by implementating planned conservation practices.

Reduce sediment load of the river and tributaries by reducing erosion.

Improve water quality on 194 miles of the Embarras River conditions from reduced sediment load, increased nutrient management, increased pesticide management and improved agricultural waste management.

Improve wildlife habitat on 40,000 acres from better woodland management, land use changes from cropland to riparian areas, buffer strips and filter strips.

Improve recreational opportunities by changing land use from cropland to woodland or riparian areas.

Convert 19,000 acres of cropland to riparian wetlands, bottom land and upland woods, or buffer/filter strips.

Improve management of flood plain cropland.

Improve management of woodland resources.

Restore bottomland wetlands on 660 acres.

Change 3,400 acres from woodland to grassland.

Improve pasture and hayland management on 10,000 acres.

A coordinated resource plan involving the implementation of restoration and protection of wetlands, structural measures, conservation land treatment, woodland management will have significant positive benefits to the natural, economic, and recreational resources of this basin.

AREAS OF CONTROVERSY

Communication and coordination need to be aggressively pursued to strengthen and maintain the cooperative relationship among the planning groups involved with this project (ERMA, Upper Embarras, and North Fork).

Communication among state and federal agencies providing financial and technical assistance should be coordinated so planning and implementation efforts will not be duplicated.

ISSUES TO BE RESOLVED

- Interagency involvement and coordination
- Implementation strategy
- Funding strategy and requests
- Administration of plan completion

INTRODUCTION

The Embarras River Basin is approximately 1,566,450 acres (2,440 square miles). The Embarras is located in southeast Illinois with drainage area in 12 counties. The basin starts on the University of Illinois campus, runs generally south through rural and agricultural land until it converges with the Wabash River in Lawrence County, Illinois (See Map 1). This plan includes parts of Champaign, Clark, Coles, Crawford, Cumberland, Douglas, Edgar, Jasper, Lawrence, and Richland Counties. Effingham and Vermilion Counties have only minor drainage area, and did not participate in the planning process.

The resource planning process was initiated by local landowners concerned about the quality of natural resources within the basin. These landowners approached the local Soil and Water Conservation Districts and the Natural Resources Conservation Service for assistance in developing long-term solutions to the resource problems that they were experiencing.

Two other earlier planning efforts in the watershed should be noted. One started within the Upper Embarras Watershed Area and involved landowners in Champaign and Douglas Counties. Another was in the North Fork tributary of the Embarras River. The efforts of these two groups is acknowledged. The current planning process seeks to assist local SWCD's in the coordination and implementation of this plan.

Planning Committee

The resource planning committee is made up of elected representatives from each county within the basin. Each county SWCD was contacted and sponsored an informational meeting about the planning process. A local steering committee was formed, and a representative was selected to serve on the Board of Directors of the Embarras River Management Association (ERMA).

ERMA is a not-for-profit corporation formed to give local landowners an organizational structure to carry on the development of a comprehensive resource plan. This effort represents a joint approach to management for the entire Embarras River Basin.

The ERMA Board of Directors are elected representatives from each county. These directors volunteer their time and talents by serving as the planning committee. They include:

Leroy Scott, President	Cumberland County
Bill Burgener, Vice-President	Richland County
Keith Donelson, Secretary	Champaign County
George Holsapple, Treasurer	Jasper County
Tom Kleiss	Champaign County
Alan Alford	Coles County
Rollie Spaniol	Coles County
Scott Finley	Crawford County
Blake Smith	Crawford County
Stan Holsapple	Cumberland County
Butch Fisher	Douglas County
Wayne Meyer	Douglas County
Joe Bergbower	Jasper County
John Probst	Jasper County
Jim Legg	Lawrence County
Dennis Williams	Lawrence County
Dave Kocher	Richland County

Objective

The objective of the Planning Committee is to develop a Comprehensive Management Plan for the natural resources in the entire Embarras River Basin. They hope to unite private citizens, public groups, and government agencies to address the resource problems related to watershed management.

Resource Concerns

The Planning Committee has identified the following priority resource concerns:

1. Flooding
2. Log Jams/Obstructions
3. Water Quality
4. Erosion
5. Drainage
6. Beaver, Deer and Turkey related problems
7. Lack of Accountability-Communication
8. Loss of Natural Character
9. Private Property Rights
10. Sediment (sand deposits)
11. Bends in the Channel
12. Wetlands
13. Wildlife/Recreation Opportunities
14. Economic Costs (funding solutions)
15. Water Usage and Supply
16. Land Use Changes
17. Small Bridge Outlets
18. Lack of Education.

Goals

The goals of the people, the public groups, and the government agencies involved in the planning process are to:

- Improve drinking water quality
- Maintain and protect drinking water supply
- Reduce erosion
- Provide flood control
- Provide better fish and wildlife habitat
- Upgrade recreational activities and facilities

Four technical advisory committees were established:

Flooding

Wayne Johanning, Facilitator
Butch Fisher
Mary Kay Solecki
Noble Brown
Lyle Wetzel
Bill Keyth
Vince Gutowski
Bill Boyd
Gary Zwilling
Diane McNaught
Karl Visser
Leroy Scott
Bob Cottingham
Pius Weibel

Erosion/Water Quality

Dennis Clancy, Facilitator
Bob Blair
Laura Keefer
Paul Terrio
Doug Brown
Rollie Spaniol
Randy Hurt
Michael Mounce
Ray Coombes
Bill Burgener
Al Coutant
Mary M. Adams
Mike Hirschi
Vince Gutowski
John Pearse
Gary Eicken
Alan Alford
Dave Shiley

Wetland, Wildlife, and Natural Character

Larry Esworthy, Facilitator
Jack Summers
Don O. Frederick
Paul A. Brewer
Kevin Woods
Keith Donelson
Bob Szafoni
Andy Cerven

Information and Public Communication

Paige Mitchell
Teresa Zimmer
Leroy Scott
Bob Wendt
Greg Carney
Kay Kitchen-Maran

RESOURCE CONDITIONS

Resources and Treatment Needs

To adequately address the resource concerns, minimum levels of treatment were identified during the planning process. This plan includes a comprehensive coordinated resource management system for the soil, water, air, plant, animal, and human resources of the watershed.

Soil

The soils of the river basin vary from flat to steeply sloping, from poorly drained to well drained, from not very erodible to very highly erodible.

Sheet, rill and gully erosion need to be treated on all land so that the average annual soil loss is at or below the "T" (Tolerable Soil Loss) value for the soil map unit. Streambank and scour erosion on bottomland need to be treated so that affected areas are stabilized. Soils disturbed by urban development and construction need to be protected so sediment does not leave the site.

Water

The stream channel of the Embarras River has an average width of 67 feet, although it varies from 122 feet to only 19 feet. The average water depth in the stream is 0.85 feet. Sand is the predominant substrate (41%) followed by gravel (21%) and silt (10%). The average Index of Biotic Integrity (IBI) for the main stem of the Embarras was 46.2 (IEPA-1987) indicating a highly valued aquatic resource. Of the 817 stream miles in the Embarras River System, 421 miles were rated as meeting full aquatic life use support.

Man's activities need to ensure that they have no negative affect on water quality. The impacts of flooding should be reduced to prevent scour erosion on bottomland areas and reduce streambank erosion. Nutrients and pesticides should be used in accordance with label instructions, plant requirements, soil characteristics, proven yield potential, and climatic factors.

Air

The quality is high during most of the year. Winter prevailing winds are from the west or north. Spring and summer prevailing winds are from the south. Occasionally odorous smoke or particulate matter moves from the urban centers. Some windstorms will carry soil particles throughout the river basin at planting time. At harvest time soil particles and dust from crops will permeate the air. Surface application of agri-chemicals may drift off-site. Offensive odors from animal waste utilization occurs frequently.

Wind blown particles of soil and smoke need to be controlled. Offensive odors from urban industrialization, livestock production facilities, and from animal waste needs to be controlled. Chemical drift during nutrient and pesticide application needs to be minimized to prevent damage to non-target plants, animals and humans or to adjacent lands and water bodies.

Plants

The river basin historically consisted of tall prairie grasses and native timber. Clearing, sodbusting, and drainage converted the area to an agri-ecosystem with crop production as the main plant cover.

Plants need to be suitable for the soil and climate conditions. Cropland, hayland and pastureland yields should be 75% or more of the high management yield potential for the soil map unit. Woodland management should meet or exceed 75% of the standard stocking guide recommended for the forest type and woodland suitability group. Adapted or native plants should be in sufficient quantity and quality to protect or improve wildlife land, recreation land and other land use.

Animals

Animals in the river basin fall into two categories: domestic and wild. Domestic livestock production is a contributor to nutrient overloads and odor problems. Several endangered species of wildlife have been identified in the river and wildlife habitat areas.

The quantity and quality of food sources for domestic and wild animals should be adequate to meet the nutritional requirements. Habitat should be managed to provide a medium to high level of quality, based on the Illinois Modified Evaluation Procedures. Endangered species are protected where appropriate through habitat protection and enhancement.

Human Factors

The total population of the river basin is 119,932 people. The rural population is declining slightly as urban areas continue to expand.

The quality of life for residents and visitors to the Embarras River Basin should be enhanced through improved diversity of environmental and economic conditions.

BASIN DESCRIPTION

Physiography (Ettinger, IEPA, 1987)

The topography of the Embarras River basin is the result of recent modification of glacial activity during the Wisconsinan and Illinoian glacial periods. The northern part of the basin, above the Cumberland - Coles County line, is within the Bloomington Ridged Plain and is described as depositional plains of low relief underlain by thick till and modified only slightly by post glacial stream erosion. The plains are nearly flat to gently rolling and are crossed by several low and poorly developed end moraines. The flatness of the plains is broken by low eskers, esker troughs, and melt water drainageways that trend southeast.

The central portion of the basin is within the Springfield Plain and extends approximately from the Cumberland - Coles County line on the north to the Richland - Jasper County line. The glacial material in this area is Illinoian in age and was not subjected to the more recent Wisconsinan glacial activity. It is underlain by lacustrine, outwash, and alluvial sediments and till and is characterized by extensively aggraded valleys. The lowlands are broad plains with low rolling hills. The northern part of the plain has less relief than the southern end.

Downstream from the Richland - Jasper County line the basin is within the Mt. Vernon Hill Country which has gently rolling topographic features that are controlled chiefly by the underlying bedrock. The uplands are well dissected, and the lowlands are broad and have low-gradient alluvial river plains.

Elevation in the Embarras River basin varies from 715 feet Mean Sea Level at its source near Urbana to 405 feet Mean Sea Level at its confluence with the Wabash River, a total fall of 310 feet. With a total river distance of 194 stream miles, this results in an average slope of 1.6 feet per mile. Headwater slopes of the main stem are relatively steep with a value of approximately 4.4 feet per mile while the middle reaches average 1.6 feet per mile. Finally, the outlet reach between the Wabash River and the USGS stream gauge at St. Marie averages only 1.2 feet per mile (See Map 2).

Geology

The surficial geology of the Embarras River drainage basin consists of a mantle of weakly consolidated to unconsolidated sediments of Pleistocene and recent age overlying Pennsylvanian-age bedrock. Bedrock exposures are relatively few in number and of limited areal extent. The nearsurface Pleistocene glacial deposits of the drainage basin include: (1) Illinois-age Glasford Formation in the southern part, and (2) Late Wisconsin-age Wedron Group in the northern part. The mapped boundary between these two subdivisions is along the southern margin of the Shelbyville and Westfield terminal moraines (SM and WM on Map 3), which were formed about 18,000 years ago.

The Glasford Formation is dominantly composed of glacial till and outwash sand and gravel deposits. In a few areas, Illinois-age eskers, kames and crevasse-filling deposits occur above the Glasford. Late Wisconsin-age deposits in the basin are composed of glacial tills, lacustrine silts and clays, outwash sand and gravels, and loess. Glacial till, which is mostly poorly sorted clay, silt, sand, and gravel, is thickest in moraines.

The location and form of Wedron Group deposits influences the configuration of the northern part of the drainage basin. Drainage divides generally occur along moraines. Map 3 depicts the surficial deposits of the basin overprinted by a pattern showing the glacial moraines in the area (abbreviations below refer to Map 3). The headwater area of the Embarras River is on the southwest side of the Champaign moraine (CM). The basin's western divide, from north to south, obliquely crosses the Pesotum (PM) and West Ridge (WRM) moraines and parallels the Arcola (AM) and Cerro Gordo (CGM) moraines before cutting across the Paris (PM) and Shelbyville (SM) moraines, cuts across the West Ridge (WRM) moraine, and over flat landscapes underlain by lacustrine deposits to the Arcola moraine (AM). After following a portion of the Arcola moraine, the divide cuts across the Paris (PM), Nevins (NM), and Westfield (WM) moraines. Like the Glasford, the Wedron is dominantly composed of glacial till and outwash sand and gravel deposits.

In south-central Champaign and eastern Douglas Counties, clayey lacustrine deposits of the late Wisconsin-age Equality Formation were deposited in lakes ponded behind the West Ridge and Arcola moraines. At the southernmost part of the basin, slackwater lacustrine deposits, also mapped as Equality Formation, overlie the Glasford within the Embarras River valley.

Sand and gravel outwash deposits of late Wisconsin-age (Henry Formation) generally occur along the outer margins of the moraines where glacial ice stagnated during gradual retreat northward. Outwash deposits are significantly larger just south of the Wisconsin terminal moraines and where glacial meltwater eroded channels through moraines. Wisconsin-age outwash also is abundant at the southern end of the basin, occurring as terrace deposits along the Wabash River.

Late Wisconsin-age silt-size loess, deposited by the wind, blankets most of the Wisconsin and older sediments (not shown in Map 3). Wind blown sand deposits (Parkland Sand) occur sporadically along the main branches of the Embarras River on the east side of the channel and south of the terminal Wisconsin-age moraine. Late Wisconsin-age and recent Cahokia Alluvium occurs throughout the drainage basin along streams and floodplains. The alluvium ranges from well to poorly sorted and consists of variable amounts of clay, silt, sand, and gravel derived from the loess, glacial till, and outwash sediments.

Soils

There are 19 soil associations within the basin (See Map 4). Approximately 70 percent of the basin area is composed of four soil associations. The Flanagan-Drummer-Catlin association and the Camden-Drummer-Starks association are dominant in the northern part of the basin (Champaign, Coles, Douglas, Edgar, and northern parts of Clark and Cumberland Counties). This part of the basin lies within Major Land Resource Area (MLRA) 108 (Illinois and Iowa Deep Loess and Drift) and MLRA 111 (Indiana and Ohio Till Plain). The Bluford-Ava-Hickory association and the Cisne-Hoyleton-Darmstadt association are dominant in the southern part of the basin. The southern part of the basin lies within MLRA 113 (Central Claypan Areas), MLRA 114 (Southern Illinois and Indiana Thin Loess and Till Plain), and MLRA 115 (Central Mississippi Valley Wooded Slopes).

The Flanagan-Drummer-Catlin association consists of nearly level to gently sloping silty soils formed in loess and the underlying glacial till or outwash on till plains of Wisconsinan age. Flanagan soils are somewhat poorly drained, Drummer soils are poorly drained, and Catlin soils are moderately well drained. They formed under prairie vegetation and are characterized by a thick, black or very dark grayish brown surface layer that is high in organic matter. Most of this association is used for cultivated crops. The soils are well suited to all of the crops commonly grown in the basin. The main management needs are measures that maintain the drainage system in areas of Drummer and Flanagan soils, control erosion in areas of Catlin soils, and maintain tilth and fertility.

The Camden-Drummer-Starks association consists of nearly level to gently sloping silty soils formed in loess and the underlying glacial outwash on outwash plains and terraces of Wisconsinan age. Camden soils are well drained, Drummer soils are poorly drained, and Starks soils are somewhat poorly drained. Camden and Starks soils formed under forest vegetation. They have a thinner, lighter colored surface layer than the Drummer soils which formed under prairie vegetation. Most of this association is used for cultivated crops. The soils are well suited to all of the crops commonly grown in the basin. The main management needs are measures that maintain the drainage system in areas of Drummer and Starks soils, control erosion in areas of Camden soils, and maintain tilth and fertility.

The Bluford-Ava-Hickory association consists of nearly level to very steep silty and loamy soils formed in loess and the underlying glacial till or entirely in glacial till on till plains of Illinoian age. This association occurs in sloping upland areas adjacent to the Embarras River and its tributaries. Bluford soils are somewhat poorly drained, Ava soils are moderately well drained, and Hickory soils are well drained. They formed under forest vegetation. Most of the nearly level to moderately sloping areas are used for cultivated crops. The soils in these areas are well suited or moderately suited to cultivated crops depending on the amount of slope. Steeper areas are mostly used for pasture, hay, and woodland. The soils are well suited or moderately suited to these uses. The main management needs in this association are measures that maintain the drainage system in areas of Bluford soils, control erosion in sloping areas, and maintain tilth and fertility,

The Cisne-Hoyleton-Darmstadt association consists of nearly level to gently sloping silty soils formed in loess and the underlying glacial till on till plains of Illinoian age. They formed mostly under prairie vegetation but have been influenced by forest vegetation at some time during their development. Cisne and Hoyleton soils are considered to be intergrades between prairie soils and forest soils and have a thin, very dark grayish brown surface layer that has moderate levels of organic matter. Darmstadt soils have a high content of exchangeable sodium in the subsoil. The exchangeable sodium restricts rooting depth and the uptake of water and nutrients. Crop yields on these soils are reduced as a result. Darmstadt soils are commonly intermingled on the landscape with the more productive Cisne and Hoyleton soils. Most of this association is used for cultivated crops. The soils are moderately suited or well suited to all of the crops commonly grown in the basin. The main management needs are measures that maintain the drainage system, control erosion in sloping areas of Hoyleton and Darmstadt soils, and maintain tilth and fertility.

Most of the major soils in these four associations that occur on nearly level to gently sloping landform positions qualify as prime farmland. Bluford, Cisne, Drummer, and Starks soils have a seasonal high water table and qualify as prime farmland only in areas where this limitation has been overcome by drainage measures. Ava, Camden, Catlin and Hickory soils that are moderately sloping or steeper are not considered to be prime farmland because of slope and the erosion hazard. Darmstadt soils are not prime farmland because of the high exchangeable sodium content in the subsoil.

Major flood plains comprise approximately 10 percent of the basin. The Beaucoup-Lawson-Darwin association occurs in the northern part and in the extreme southern part of the basin. Beaucoup and Darwin soils are poorly drained or very poorly drained. Lawson soils are somewhat poorly drained. These soils typically are silty clay loam in texture and have a thick, very dark gray or black surface layer.

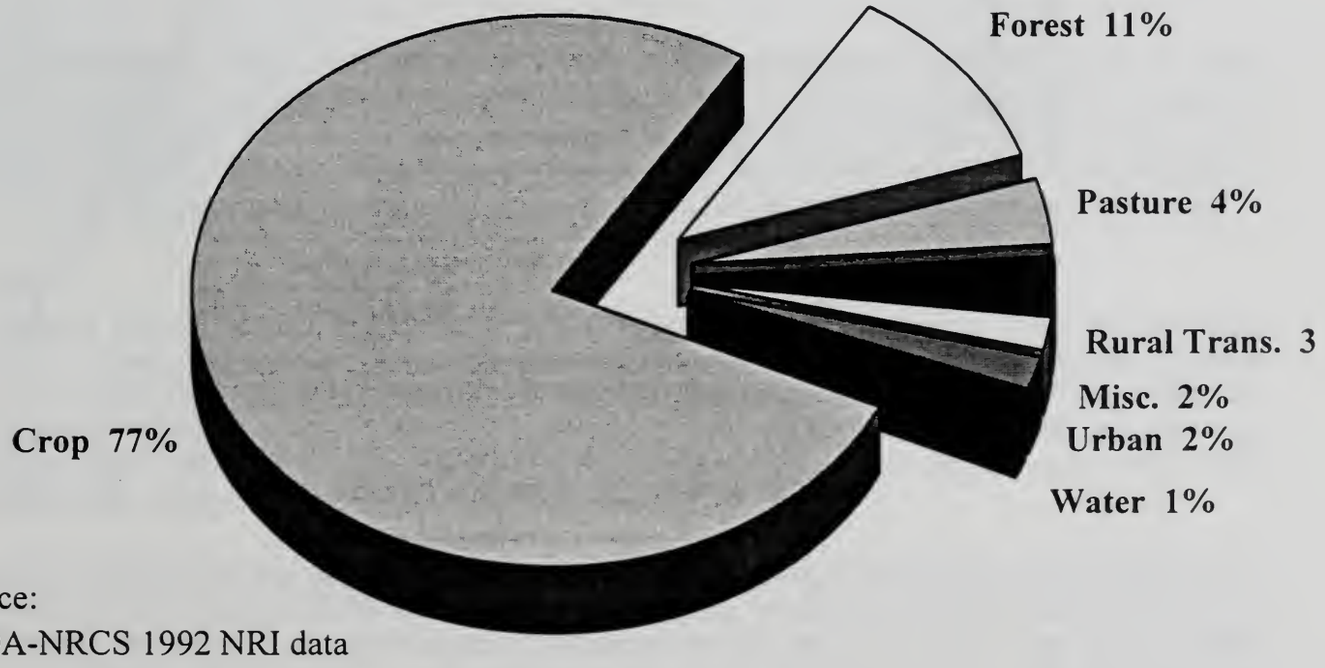
The Wakeland-Birds-Belknap association occurs in the southern part of the basin. Wakeland and Belknap Soils are somewhat poorly drained. Birds soils are poorly drained, typically are silt loam in texture and have a thin, brown or dark grayish brown surface layer.

Soils that occur on flood plains within the Embarras River Basin are subject to occasional or frequent flooding for brief to long periods between January and June of most years. Damage to crops can occur if flooding occurs after planting for extended periods. Most areas are used for cultivated crops. Some areas have been left in woodland. The main management needs are measures that maintain the drainage system, protect crops from floodwater, maintain tilth and fertility, and protect streambanks from erosion.

Land Use

Land use estimates in the Embarras River Basin from the USDA-NRCS National Resource Inventory by different categories is shown below:

Figure 1. 1992 Land Use



Source:
USDA-NRCS 1992 NRI data

Climate

The climate within the Embarras River Basin is humid continental, with the weather principally influenced by masses of cold polar air moving to the east across the basin and by warm moist gulf air masses crossing the basin from the south toward the east. Prevailing winds, in order of importance, are from the southwest, west, and northwest.

The average monthly temperature and precipitation is shown in the following graphs for Tuscola and Newton during the 30-year period, 1961 to 1990. Tuscola is in the northern end of the river basin and Newton is in the southern end.

Figure 2.

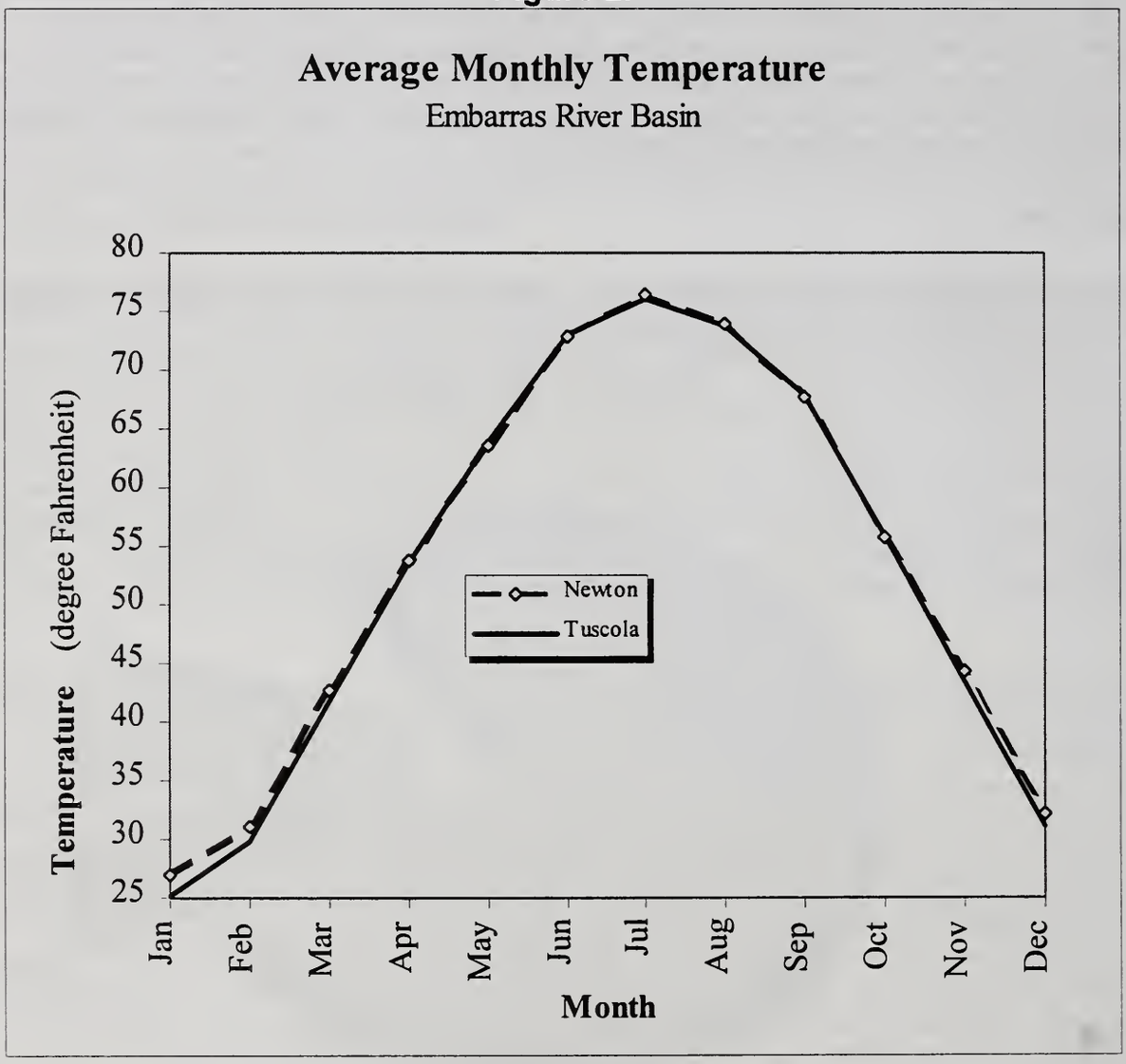
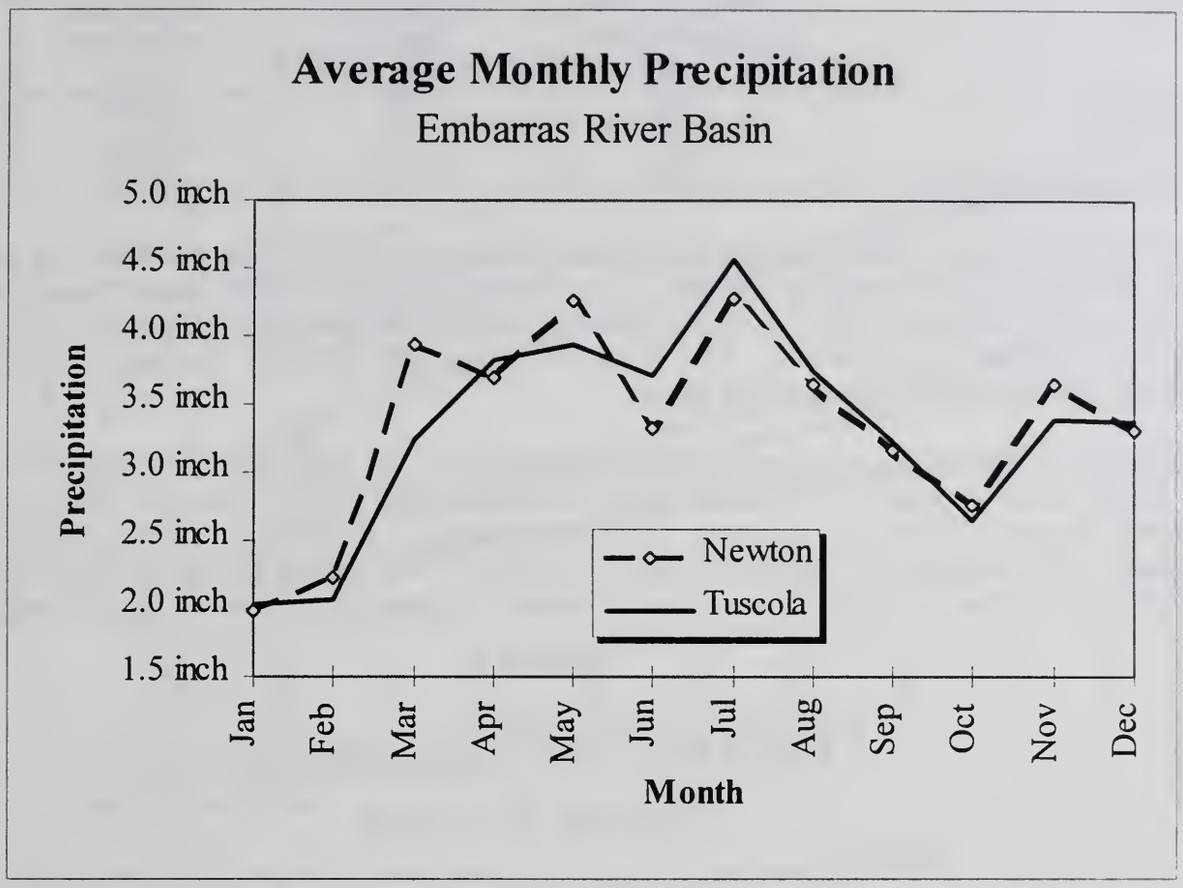


Figure 3.



During summertime, when gulf air masses control the precipitation pattern, there is wide variation in rainfall over the basin. Heavy thunderstorm rainfall may occur over a principal tributary causing main stem flooding in an area which may have experienced no rainfall. The combination of highly variable summer precipitation with poor moisture retention characteristics of the soil often produce very droughty areas when the actual rainfall is near the average value.

Hydrology

The Embarras River Basin is approximately 110 miles long (the Embarras *River* is 194 miles long due to meandering within the basin), but only about 25 miles wide. In addition, the main channel is relatively flat when compared to the steep tributary slopes. Thunderstorm precipitation, which may be very intense, but limited to a rather small area of the river basin, may be locally severe. However, flooding may not result on major portions of the main stem of the Embarras River because the basin is so long and narrow.

In general, it has been found that very heavy storms tend to have nearly west-to-east orientations. (*Illinois State Water Survey Bulletin 70*). This is fortunate, because the Embarras River Basin is oriented west-northwest to south-southeast. It is apparent that main stem flooding at Ste. Marie, where the drainage area is 1,516 square miles, is not principally associated with thunderstorm precipitation. The same conclusion may be stated for the points further downstream than Ste. Marie because of the increasing size of the drainage area. (Embarras River Basin Study Flood Control Report, Illinois Department of Transportation - Division of Water Resources, September 1976)

Stream flow characteristics for the Embarras River and the North Fork tributary at three different United States Geological Survey (USGS) gauging stations are shown in the following table:

Table 1. Stream Flow Characteristics				
Gauge	Drainage Area (square miles)	Average Daily Flow (cfs)	Maximum Daily Flow (cfs)	Period (years)
Camargo	186	168	6,150	1961-1994
Ste. Marie	1,516	1,253	38,200	1910-1994
Oblong (*North Fork*)	318	269	20,300	1941-1994

The following graph shows the estimated peak discharge of the Embarras River by frequency at three different USGS gauging stations. The Diona gauge has been discontinued and was not listed in the previous table. For purposes of clarity, the gauging station on the North Fork tributary (Oblong) is not shown. The 2-year, 10-year, and 100-year discharge estimates are the bottom, middle, and top lines in the graph.

The estimates shown above do not include the portion of the Embarras River below the mouth of the North Fork tributary. To show these estimates, the 1976 *Embarras River Basin Flood Control Report* (Illinois Department of Transportation - Division of Water Resources) listed estimates for drainage areas from 900 square miles to 2,440 square miles (mouth of the Embarras River). The 5-year, 10-year, 15-year, and 100-year estimates are shown in the following graph.

Figure 4.

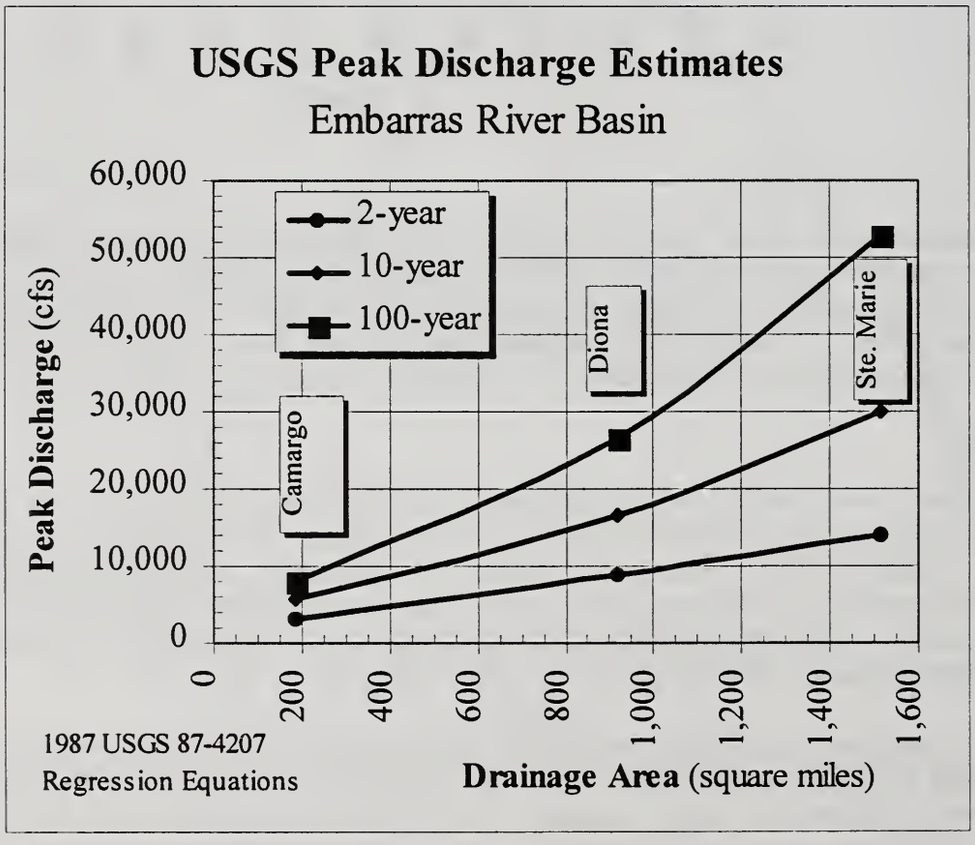
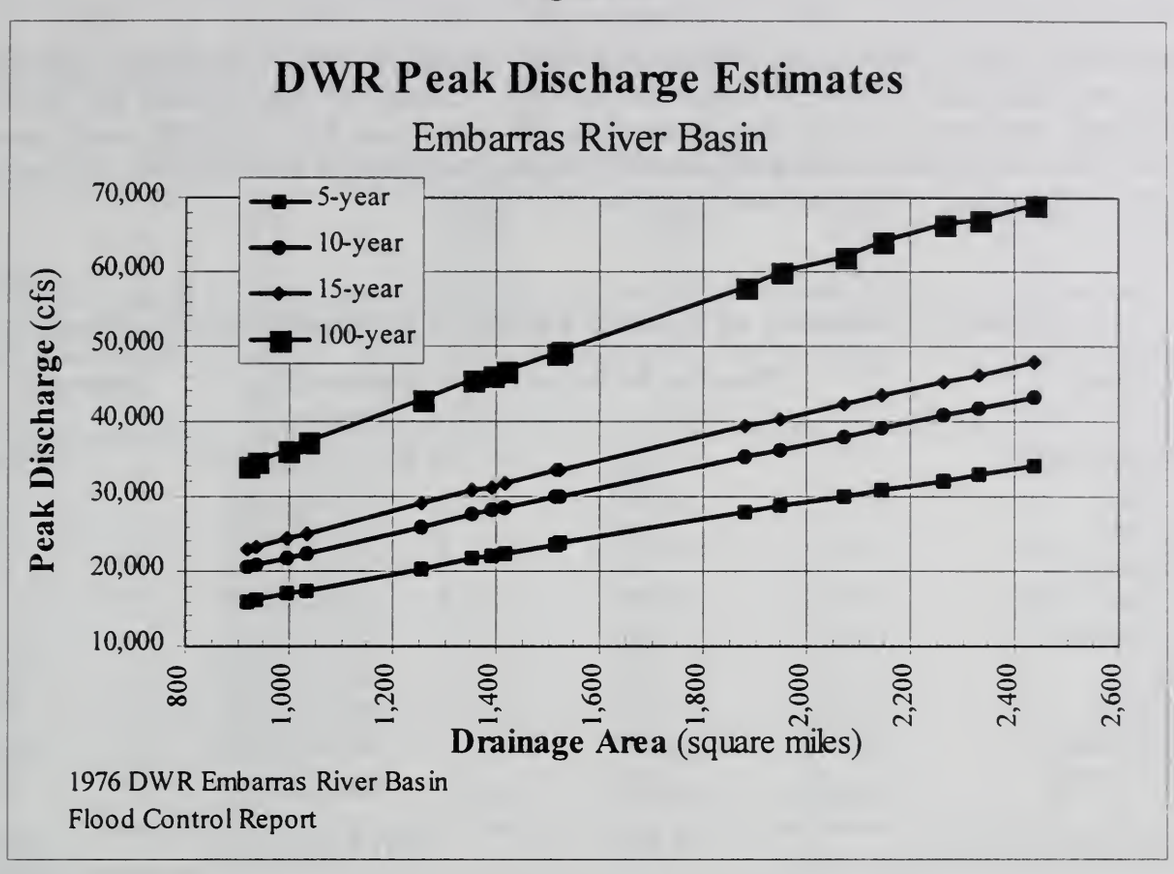


Figure 5.



Transportation Network

The Embarras River Basin has a well developed transportation system composed of federal interstate highways, state highways, main county roadways and farm to market roads. This road system blankets the river basin from its origin in Champaign County to the confluence in Lawrence County. There is also a network of passenger (AMTRAK) and freight railroads serving the area.

Major highways running north and south are: I-57 crosses the north and western part of the basin from Champaign to Mattoon; IL-130 crosses the central part of the river basin from Philo in Champaign County to near Dundas in Richland County; IL-49 crosses the eastern side of the basin from Highway 36 in Edgar County to Highway 33 in Jasper County; IL-1 crosses the basin in Lawrence County.

Major highways running east and west are: I-70 angles northeast across the central part of the basin from Montrose in Effingham County to Martinsville in Clark County; IL-36 crosses the northern part of the basin from Atwood in Douglas County to Hume, in Edgar County; IL-133 crosses the northern part of the basin from Arthur in Douglas County to Redmon in Edgar County; IL-16 crosses the north central part of the basin from Mattoon to Charleston in Coles County, to Kansas in Edgar County; IL-33 crosses the south central part of the basin from Wheeler in Jasper County to Oblong in Crawford County; IL-50 crosses the southern part of the basin from Sumner to Lawrenceville in Lawrence County.

Agriculture

Agriculture plays a role for the residents of the Embarras Basin. The major crops grown in the basin are corn and soybeans. Based on the 1992 Census of Agriculture, the market value of agriculture products sold in the counties in the basin are $717,357,000, with an average of $98,654 per farm as shown in the following table. Statistics are not available for portions of each county in the basin, so county-wide statistics are used.

Table 2. Number of Farms/Value of Agricultural Production

County	Number of Farms	Value of Ag. Produce	Average Value/Farm
Champaign	1,452	$160,064,000	$110,237
Clark	685	57,686,000	84,213
Coles	700	65,038,000	92,911
Crawford	543	52,961,000	97,535
Cumberland	645	50,833,000	78,810
Douglas	682	79,241,000	116,189
Edgar	823	92,146,000	111,963
Jasper	772	69,735,000	90,330
Lawrence	365	44,043,000	120,667
Richland	545	45,610,000	83,687
Totals/Average	**7,212**	**$717,357,000**	**$98,654**

Crops constitute 80% of the value of agricultural products sold while the sales from livestock is 20%.

Based upon Illinois Agricultural Statistics, crop yields in the study are some of the best in the state and illustrated as follows with 1994 yield averages for corn and soybeans. Again, statistics are not available for portions of each county in the basin, so county-wide statistics are used.

Table 3. 1994 Average Crop Yields

County	Corn	Soybeans
Champaign	161	51.0
Clark	146	43.0
Coles	166	47.0
Crawford	122	37.5
Cumberland	156	44.0
Douglas	161	51.5
Edgar	158	49.5
Jasper	140	41.5
Lawrence	120	40.5
Richland	121	40.0
State of Illinois	156	46.0

The following illustrates the unemployment rate trends for the basin as compared to the state and the U.S. Edgar and Lawrence counties are designated labor surplus areas due to their unemployment rates as determined by the Secretary of Labor. Note that statistics are not available for portions of each county in the basin, so county-wide statistics are used.

Table 4. Unemployment Rates (%) By County

County	1990	1991	1992	1993	1994	1995
Champaign	6.1%	4.5%	4.8%	5.4%	3.9%	3.4%
Coles	6.2%	6.5%	6.9%	6.2%	4.4%	4.3%
Clark	8.4%	8.4%	8.1%	7.0%	5.3%	4.6%
Crawford	9.2%	10.5%	8.7%	7.6%	8.2%	7.5%
Cumberland	10.0%	10.2%	9.5%	7.8%	5.9%	5.8%
Douglas	5.2%	6.5%	7.8%	7.2%	5.4%	4.5%
Edgar	8.6%	8.7%	9.4%	9.0%	6.5%	5.0%
Jasper	7.1%	8.8%	8.6%	8.2%	6.9%	6.2%
Lawrence	9.5%	10.4%	10.4%	9.1%	8.5%	8.5%
Richland	8.7%	8.0%	7.1%	6.0%	5.9%	4.7%
State of IL	6.2%	7.1%	7.5%	7.4%	5.7%	5.2%
U.S.	5.5%	6.7%	7.4%	6.8%	6.1%	5.6%

Population

The Embarras River Basin is considered a rural area and sparsely populated. Based upon the 1990 Census, the area experienced a decline since 1980. The following table shows the median age, population, and population density for the ten county area. The county-wide values for median age and population density are representative of the river basin. The population values are not county-wide, but only include census blocks in the basin.

Table 5. Median Age, Population, and Density

County	County-wide Median Age	1990 Population Within Embarras River Basin	County-wide Density People per sq. mi.
Champaign	27.8	14,544	173.5
Clark	37.0	7,158	31.7
Coles	29.8	41,071	101.6
Crawford	37.1	7,147	43.9
Cumberland	33.9	8,367	30.8
Douglas	34.5	14,389	46.7
Edgar	37.3	2,921	31.4
Jasper	34.4	9,303	21.5
Lawrence	38.0	13,789	42.9
Richland	35.6	1,243	45.9
Total		119,932	49.2

The following table shows the 1990 population diversity in the Embarras River Basin ten county study area. These values are not county-wide, but only include census blocks in the basin.

Table 6. Population Diversity

County	White	Black	American Indian Eskimo	Asian Pacific Islands	Other
Champaign	13,570	395	15	539	25
Clark	7,117	2	12	21	6
Coles	39,769	814	78	321	89
Crawford	7,113	10	11	8	5
Cumberland	8,341	3	5	14	4
Douglas	14,220	12	18	32	107
Edgar	2,909	1	8	1	2
Jasper	9,274	1	11	14	3
Lawrence	13,586	143	29	21	10
Richland	1,241	1	0	1	0
Total	117,140	1,382	187	972	251
Percent	97.7%	1.2%	0.2%	0.8%	0.2%

Note: Percent totals do not add to 100% due to rounding.

PROBLEMS AND OPPORTUNITIES

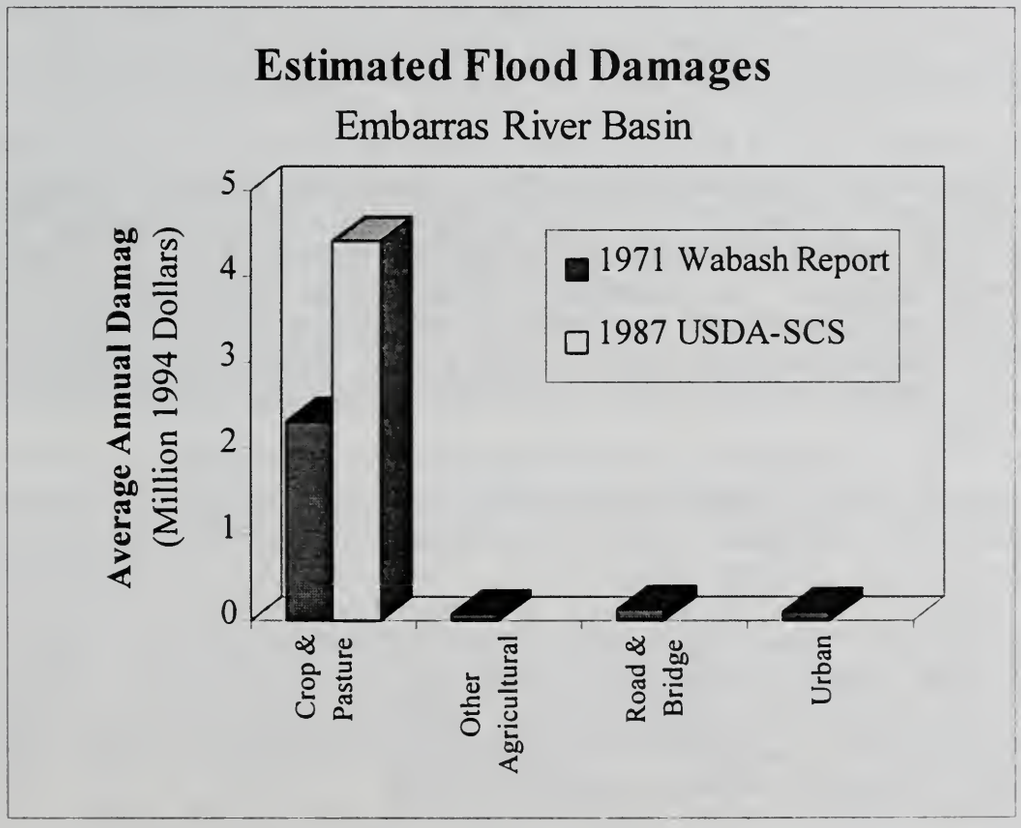
Priority Resource Concerns

Flooding

Two published sources estimate flood damages in the Embarras River Basin. The 1971 Wabash River Basin Comprehensive Study *(Wabash River Coordinating Committee; Volume IX - Appendix H Agriculture; June 1971)* reported the average annual flood damages in the basin for several categories including: crop and pasture, other agricultural damages, road and bridge, and urban. The cost basis for this report is 1966 dollars. It is clear that the primary flood damage is agricultural crops, not transportation or urban damages.

The State of Illinois Hydrologic Units report *(USDA - Soil Conservation Service, July 1987)* provides a single estimate for agricultural damages for the Embarras River Basin. The cost basis for this report is 1983 dollars. These estimates, updated to 1994 dollars, are shown in the graph below.

Figure 6.



The 1976 Illinois Department of Transportation Division of Water Resources report established the 15-year flood profile, but this area was not mapped. The 1987 State of Illinois Hydrologic Unit report estimates the area in the basin subject to flood damage is 149,900 acres.

Log Jams/Obstructions

Log jams and sediment bars cause problems in the river that forces it to change the normal channel flow. Small log jams form restrictions in the channel widen the channel through bank erosion. Larger log jams divert flow onto adjacent land, change the direction of the normal channel flow and are potential safety hazards to private and public resources. Sedimentation is the result of normal stream channel dynamics and "bed load" conditions. As the river meanders, sediment bars are deposited on the inside of meander curves where the velocity of water flow is lower. In March 1995, a helicopter was used to video tape the Embarras River and its major tributaries to inventory the extent of the log jam and obstruction situation (See Map 5). Nine major log jams were recorded that appear to be causing extensive flow alterations. These jams need to be evaluated.

A resource management team of professional scientists and public people needs to be established to evaluate log jam and obstruction situations. This team could determine criteria and evaluate the extent of damages caused by individual log jams and obstructions and determine appropriate action.

Water Quality

From April through October 1987, the Illinois Environmental Protection Agency (IEPA) conducted an intensive survey of the Embarras River, a seventh order tributary to the Wabash River, and several of its major tributaries to evaluate the aquatic resources of the basin. The following information is taken from the *1987 IEPA Intensive Survey of the Embarras River Basin.*

The Embarras River, in particular the section between the towns of Greenup and Newton has been characterized as one of the finest aquatic natural areas remaining in Illinois. Water chemistry, fish, macroinventebrate and habitat data were collected at 25 stations to assess the basin's biotic potential. An additional 31 stations were also sampled on smaller tributaries throughout the basin for all data except fish. From the data collected, environmental quality was summarized utilizing various indices including water quality index (WQI), macroinvertebrate biotic index (MBI), fish index of biotic integrity (IBI), and habitat potential index of biotic integrity (PIBI).

Water quality within the basin was in excellent to very good condition with only minor water quality problems. The mean of water quality index for the Embarras River was 31.4 and the tributaries were only slightly higher at 35.2. Total suspended solids and phosphorus were the primary causes of elevated WQI values. An impact from point source discharges was evident at only five stations. These stations had WQI's that indicated at least moderate water quality problems from ammonia, phosphorus and/or specific conductance. Violations or potential violations of the state's general use water quality standards occurred from iron (25 sites), phosphorus (14 sites), manganese (910 sites), dissolved oxygen (8 sites), total dissolved solids (3 sites), pH (1 site), and unionized ammonia (1 site).

A total of 79 macroinvertebrate taxa were collected from 15 Embarras River stations while 102 taxa were collected from the 41 tributary sites. Species richness was good with an average of 28 per station on the Embarras and only slightly fewer on the tributaries with 22. Only five sites had 10 or fewer macroinvertebrate taxa and all were associated with either a municipal wastewater treatment plant or with oil field brine problems. MBI values on the main stem ranged from a high of only 6.4 to a low of 4.3 with an average of 5.0 reflecting very good stream quality. For the tributaries, the MBI ranged from a high of 8.2 to a low of 4.4 with a mean of 5.6 indicating very good stream quality.

During 1986-87, the Illinois Natural History Survey conducted a study of the mussel populations in the Embarras River. This study which incorporated 25 main stem sites found that an 86% reduction in the total mussel population had occurred since 1956. Unfortunately, no cause for this decline was given. A further finding of the study was that of the 39 mussel species reported for the Embarras River, nine have been proposed for the state endangered species list and one (Cyprogenia stegaria) is also a candidate for federal endangered status.

Main stream width for the Embarras River was 67 feet although it varied from 122 feet near Newton to only 19 feet wide near Philo. Average water depth in the stream was 0.85 feet. Sand was the predominant substrate with 41% of the total followed by gravel (21%) and silt/mud (10%). The average predicted IBI for the main stem Embarras was 46.2 indicating a highly valued aquatic resource.

Individual station values ranged from 49.8 to 39.5. Tributary streams, which were all at least third order, varied greatly in size from 53 feet wide and 1.2 feet deep to only 9 feet wide and 0.2 feet deep. Tributary instream substrate was composed primarily of sand (25%), gravel (23%), silt/mud (20%) and plant detritus (15%). A total of 25 tributaries were rated as highly valued aquatic resources while the remaining 16 were rated as moderately valued aquatic resources.

A total of 62 fish species from 12 families were collected at 25 stations on the Embarras River and its tributaries in October 1987. IBI values on the main stem Embarras ranged from 28 to 50 with a mean of 38 placing the Embarras River in the moderately valued aquatic resource category overall. Only three stations were rated as highly valued and all three were located in the middle section below Lake Charleston and above St. Marie. The further downstream station at Billett was rated as a limited aquatic resource. With only three major dischargers in the basin and no known industrial or nonpoint runoff problems, the average IBI for the Embarras appears to be lower than expected especially since several respected authors have rated the Embarras, and in particular the middle section, one of the outstanding streams in Illinois. Several factors probably depressed the observed IBI's. Excessive stream width, particularly below Lake Charleston, was probably the main cause since it permitted fish to escape around the sampling area. Reduced visibility from disturbed silt may also have contributed to the lower IBI's. IBI values for the tributaries ranged from 32 to 50 with a mean of 41. Four of the ten sites were rated as moderate aquatic resources while the remaining six were highly valued aquatic resources.

According to a list of threatened and endangered species published by the Illinois Species Protection Board, there are three endangered fish species in the Embarras River including the bigeye chub, the harlequin darter, and the eastern sand darter. In addition, the bigeye shiner is on the state threatened list.

Of the 817.0 stream miles in the Embarras River System, 420.7 miles were rated as meeting full aquatic life support. With the exception of one Embarras River segment near Charleston, all fully supported river miles were tributaries. Approximately 354.0 miles were classified as achieving partial use support with minor impairment including 160.6 miles of the main stem Embarras along with a number of smaller tributaries. There were only three tributaries comprising 39.6 stream miles which provided partial use support with moderate impairment. Finally, Dogwood Creek was the only stream classified as non-supportive of aquatic life. Approximately 5.0 miles were impacted by the discharge from the Oblong municipal wastewater treatment facility.

See Map 6 and its legend indicating degree of overall use support for Wabash River Basin, which includes the Embarras River Basin. This map was taken from Volume I of the *1992-1993 IEPA Illinois Water Quality Report*. This report describes water quality conditions by the degree of designated use attained by the stream reach. For example:

Full Support - The water quality meets the needs of all designated uses protected by applicable water quality standards.

Full Threatened - Water Quality is presently adequate to maintain designated uses, but if a declining trend continues, only partial support may be attained in the future.

Partial Support/Minor Impairment - Water quality has been impaired, but only to a minor degree. There may be minor exceeds in applicable water quality standards or criteria for assessing the designated use attainment.

Partial Support/Moderate Impairment - Water quality conditions are impaired to a greater degree inhibiting the waterbody from meeting all needs for that designated use.

Nonsupport - Water quality is severely impaired and not capable of supporting the designated use to any degree.

A water quality report by Akambi and Demissie, Office of Sediment and Wetland Studies, Illinois State Water Survey, June 1994, indicated trends in suspended sediments and sedimentation in Illinois streams. According to this report, the distribution of sediment yield rates for the Embarras River Basin is moderate to low. The highest sediment yield rate occurs in Region 4, and lowest sediment yield rate occurs in Region 1. Embarras River Basin yield rate occurs in Region 2. See Map 7, indicating distribution of sediment yield rates in tributary drainage basins.

In the Upper Embarras River Basin, nitrates have been found to be high for normal stream flows. Nitrate is a matter of concern as a water contaminant because of its effects on health and because it stimulates algal growth. Nutrients and pesticides move to the river in runoff water or attached to sediment. The cropland, particularly cropland planted to corn, contributes most of the nutrients and pesticides that reduce water quality.

Although there is no state water quality standard for total suspended solids (TSS), a criterion of 25 mg/l is used in calculating the water quality index. It was an important parameter in the Embarras River Basin since elevated WQI values during the intensive survey were primarily caused by elevated TSS. Concentrations ranged from 338 mg/l on Cottonwood Creek near Jewett to only 3 mg/l on Polecat Creek near Ashmore. Mean concentration of TSS in the Embarras River was 53 mg/l and 51 mg/l was the mean for all tributary sites.

Total suspended solids are normally associated with sediment particles in the water column. These sediment particles can originate as non-point runoff from agricultural areas such as row crops and livestock feedlots. Other major nonpoint sources of sediment are streambank erosion, urban stormwater runoff and the activity of bottom feeding fish such as carp. During this study unicellular algae were also a major source of TSS, particularly during the summer when stream flow was reduced due to lack of rainfall and there was no runoff.

Erosion

Soil erosion is a problem in almost all Illinois watersheds. Sheet and rill erosion was evaluated on the entire Embarras basin. Estimated rates of erosion were established using the NRCS NRI data for 1992 and represent the midpoint of all six classes listed (See the following figures for cropland and pastureland). Totals for all erosion sources are listed in Table 7-Estimated Annual Erosion and Sedimentation in the Sedimentation section. Total gross erosion is estimated to be 6,725,980 tons, of which approximately 77 percent is from sheet and rill erosion.

Figure 7.

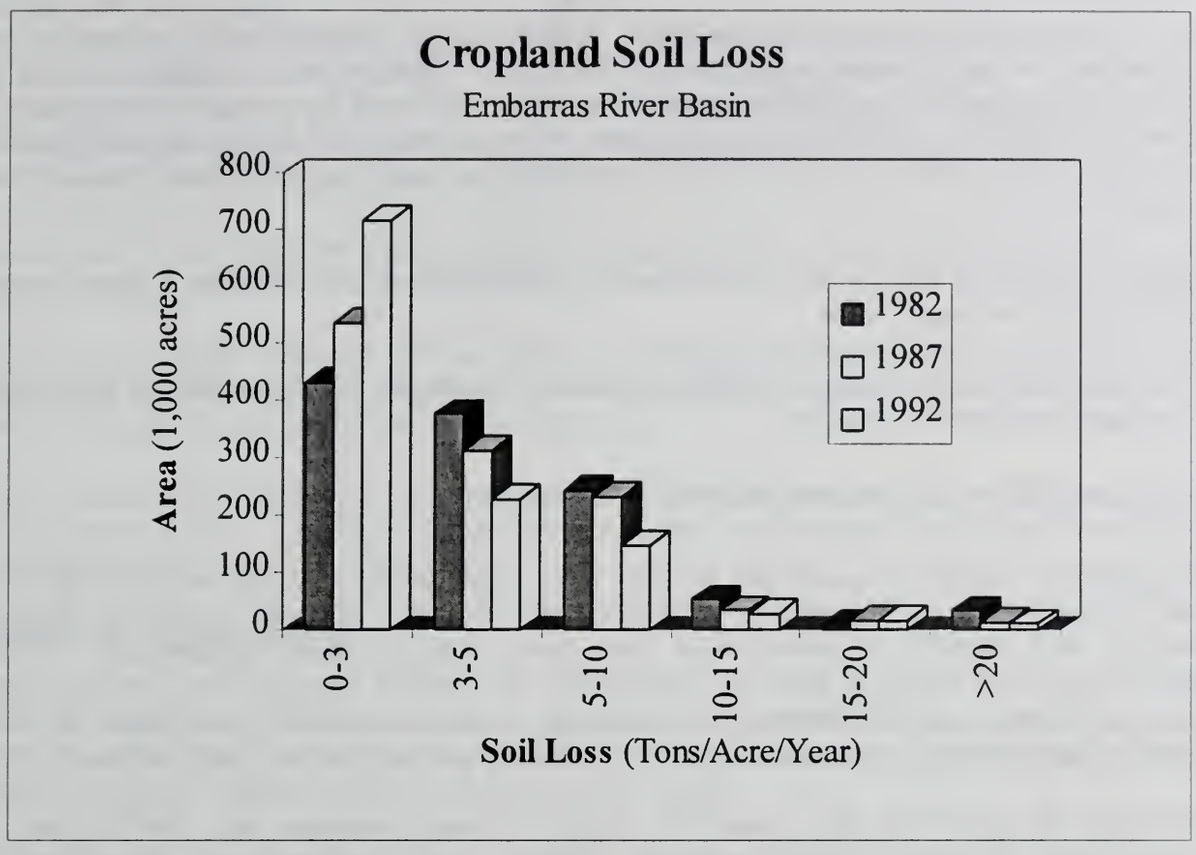
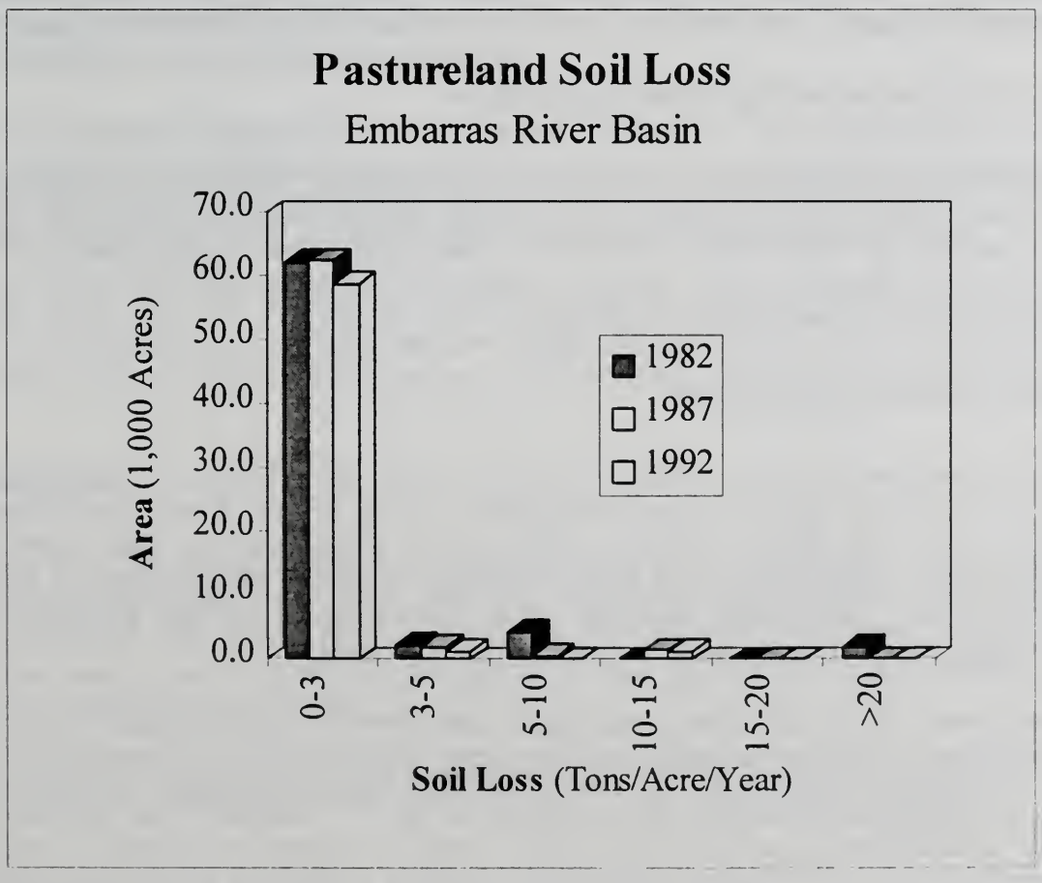


Figure 8.



Drainage

Some drainage concerns exist in the basin. Drainage has been and will continue to be a major requirement for agricultural production in the basin. Surface and subsurface drains have been installed in the basin by individual landowners since 1850 and by mutual or organized groups of landowners beginning in 1895. Maintenance and replacement of the drainage improvements are continuing at the present time and will be important economic and environmental action items in the future.

Drainage guidelines and general maintenance considerations for drainage systems are discussed in the Illinois Drainage Guide.

Appropriate wetland agencies should be contacted to ensure that the activities fully comply with the wetland regulations in effect.

Beaver, Deer, & Turkey Related Problems

The planning committee identified beaver, deer, and turkey as three wildlife species causing some problems with landowners in the watershed. Flooding of crops caused by beaver dams on tributaries and erosion of streambanks have been cited by some landowners. Wildlife have caused some crop damage, been an enticement to trespass hunters, and caused some vehicle accidents. These can be viewed as incidental situations, which can/should be handled by individual landowners in consultation with the Illinois Department of Natural Resources.

Practices in the plan that may lessen the effects of these damages are: buffer zones, restoring wetlands, and timber stand improvement (if good mast producers are favored). In addition, properly structured hunting and trapping programs may be of benefit. Contact the Illinois Department of Natural Resources for advice on how best to treat depredation cases

Lack of Accountability/Communication

Communication and coordination needs to be aggressively pursued to strengthen and maintain the cooperative relationship among the planning groups involved with this project (ERMA, Upper Embarras, and North Fork). In addition, communication among state and federal agencies that can provide financial and technical assistance needs to be facilitated so planning and implementation efforts will not be duplicated.

Loss of Natural Character

A significant segment of the Embarras River is on the State Natural Areas Inventory, and also qualifies for National Scenic River designation. This Scenic River area extends from Lake Charleston to the Old Mill at Newton. This Scenic River area has been listed because of the natural character, scenic beauty and wildlife habitat. It is frequently used for canoeing, fishing, hunting and other recreational activities. The natural character has intrinsic, biological, and physical importance for threatened and endangered species.

The recreational value of this area contributes significantly to the economic resources of the area. An IDNR fishery biologist has estimated that sport fishing on the Embarras River is $8,000,000 annually. Hunting, picnicking, bird watching and other recreation are tied to the natural character of the area.

The land in the Embarras River Basin is predominantly privately owned. Areas of state-owned land in the river basin are:

Walnut Point State Park
Fox Ridge State Park
Sam Parr State Park
Red Hills State Park
Chauncey Marsh Nature Preserve
Chauncey Marsh INAI
The Slough INAI
Robeson Hills Nature Preserve
Robeson Hills INAI

Illinois Natural Area Inventory sites are listed in Appendix B. These sites may be state owned or privately owned.

As economic pressures increase, and as land units change ownership, the potential for land use changes from natural areas to cropland production will increase. Each year there is more pressure to change the natural character of this area.

Increased amounts of water flow, volume, and frequency is another threat to the natural character of the Embarras River. Damages to the river channel and natural flood plain area reduce its scenic beauty.

Private Property Rights

Landowners throughout the Embarras River basin have apprehension about any plan that affects freedom to use their land as well as any potential liability. The planning committee chose not to give this issue to a technical advisory committee for study.

Landowners may view any resource problem solution that restricts the land use as an infringement on private property rights. In the same manner, solutions to resource problems involving actual or perceived public access to private property raise unresolved questions about landowner liability in cases of accidental injury.

The resource treatments suggested in this plan are intended to be implemented on a voluntary basis either through landowner's private initiative or with the assistance of public cost-share assistance with funding. Suggested practices to resolve resource will meet the standards and specifications of the supervising agency and will not create public safety hazards.

This resource plan does not attempt to resolve issues of freedom or liability. However, the Embarras River Management Association is an organization that can set up an advisory team and make recommendations about private property rights and liabilities to landowners and public lawmakers.

Sedimentation

Sedimentation is an on-going natural process that occurs in all watersheds. Sediment deposition occurs throughout the basin in low spots and depressions, along field borders, on flood plains, in stream channels, and wherever slight variations in the velocity of silt-laden water takes place. Sediment deposited in one rainfall may be picked up and moved in another rainfall event. This process may be repeated many times.

A Sediment Delivery Rate (SDR) was applied to each type of erosion to calculate that portion that was "available for transport". Only a portion of the sediment produced by soil erosion actually reaches a stream or transport system. Much of the sediment produced by sheet and rill erosion is deposited before entering a stream. Conversely, literally all of the sediment produced by streambank erosion enters a watercourse directly.

A Sediment Transport Efficiency Factor accounts for the variation in the ability of streams and their tributaries to transport sediment. Generally, as watersheds become larger, the streams become more meandering, and the stream gradient flattens, the ability to transport sediment is significantly reduced. In the Embarras River Basin, approximately 5,180,000 tons of sediment enters the stream system on an annual basis. Of this total, about 1,295,000 tons is expected to move through the system.

Table 7. Estimated Annual Erosion and Sedimentation

Type	Erosion (tons)	Sediment Delivery Rate	Sedimentation (tons)
Sheet & Rill	5,172,800.[1]	0.75	3,879,600
Ephemeral	775,920.[2]	0.85	659,500
Gully	683,760.[3]	0.80	547,000
Streambank	93,500.[4]	1.00	93,000
Total	6,725,980		5,180,000

[1] National Resources Inventory Data-1992, average values within groups

[2] 15% of sheet and rill erosion totals

[3] Based on an estimated 7,400 miles of gullies in the entire watershed, using average rate of erosion from 5 similar watersheds.

[4] Based on 657 miles of direct tributaries to the Embarras River and 576 miles of secondary tributaries.

Bends in the Channel

As the Embarras River flows through the basin, it tends to meander, creating numerous bends. In the lower half the grade flattens out, and the meandering of the river increases which is typical of a river this size. The bends move back and forth over time across the floodplain. Landowners and operators farming along the river reported losses of up to 10 rows of crop (25 feet) as the river bend advances. Eventually the river jumps across the neck of the bend leaving isolated sloughs or oxbows. Activities of people and their structures in the floodplain come into conflict with the river as it moves. It is estimated that 57 miles of streambanks along the Embarras are actively eroding enough to need treatment.

The 1976 IDOT Study of the Embarras River Basin detailed some of the more restrictive bends.

Wetlands

The National Wetland Inventory completed by the U.S. Fish & Wildlife Service lists 100 different kinds of wetlands found along the Embarras River. These are broadly classified as:

Riverine (includes the river and its tributaries)
Palustrine (lowland areas that hold water)
Lacustrine (lakes, reservoirs, and impounded rivers)

They are further broken down by the type of bottom structure, dominant vegetation, frequency of flooding, and time period flooded. By far the most area was Palustrine with 120,194 acres. The single most common type of Palustrine wetlands is woodland that is temporarily flooded with 72,000 acres. Lacustrine was next with 3,881 acres, and Riverine had 3,524 acres. This totals almost 127,600 acres or 7.7% of the total land in the watershed (1,566,450 acres). The variety of wetlands in the Embarras River contributes to the variety of aquatic species found in the Embarras River Basin.

Practices from the plan will protect wetlands from further siltation, which will prolong their existence. Restoring wetlands will slow stormwater runoff, filter excess nutrients from the runoff, recharge groundwater supplies, decrease flooding and increase habitat for threatened and endangered species. Over 40% of Illinois' threatened and endangered species depend on wetlands. Of these species, the ones found in and around the Embarras River Basin are listed in the following table.

Table 8. Illinois Threatened and Endangered Species - Wetland Dependent

Birds	**Mussels**	**Plants**
Henslow's Sparrow	Spike	Running Pine Moss
Least Bittern	Elephant-ear	Water-pennywort
Pied-billed Grebe	White Warty-back Pearly	Drooping Sedge
King Rail	Kidneyshell	Broomrape
Short-eared Owl	Little Spectacle Case	Large-seeded Mercury
Bald Eagle	Rainbow	Halbred-leafed Tearthumb
Northern Harrier	Snuffbox	
Red-Shouldered Hawk	Purple Lilliput	
Common Moorhen	Rabbitsfoot	
	Ebonyshell	
	Sheepnose	
Fishes	**Butterflies**	**Reptiles**
Eastern Sand Darter	Swamp Metalmark	Kirtland's Snake
Harlequin Darter		
Bigeye Chub		
Bigeye Shiner	**Amphibians**	**Mammals**
	Four-toed Salamander	Indiana Bat
		River Otter

Wildlife Habitat

Most terrestrial plant communities display gross modification as a result of human disturbance including logging, grazing, cultivation, and residential development. The main existing plant communities and dominant species are as follows: cropland (corn, soybeans, wheat); roadsides (bluegrass, brome, fescue); permanent pasture (bluegrass, brome, fescue); forest (Upland-white oak, red oak, shagbark hickory and bottomland-cottonwood, silvermaple, sycamore, black walnut, bur oak); and farmsteads and urban areas (bluegrass, ornamental shrubs, conifers, and deciduous shade trees).

The wildlife resources of the watershed consist of species associated with previously described plant communities. Open water environments and wetlands provide habitat for many species of migrant and resident waterfowl, wading birds, shorebirds, and raptors. Representative species include great blue heron, green back heron, common snipe, spotted sandpiper, solitary sandpiper, wood duck, mallard , and greater yellowlegs. Mammals utilizing these areas include raccoon, mink, muskrat, and beaver.

Bottomland forest remnants along the streams in the area are the preferred habitat of mammals such as the raccoon, beaver and opossum. Avian species utilizing the bottomland forest include the great blue heron, wood duck, red-shouldered hawk, barred owl, brown creeper, prothonotory warbler and the American redstart.

Upland forests are typically occupied by mammals such as masked shrew, keen's bat, gray fox, fox squirrel, deer mouse, and white tailed deer. Birds representative of upland forest are the red tailed hawk, great horned owl, red-headed woodpecker, tufted titmouse, and yellow-breasted chat.

Grasslands, including prairie remnants, roadsides, hay fields, and pastures are relatively uncommon. Because of their general scarcity they are quite valuable for a variety of wildlife species. These include such birds as the savannah sparrow, grasshopper sparrow, dickcissel, meadowlark, kestrel, and even the state endangered upland sandpiper and prairie chicken. Mammals of the grasslands are the thirteen-lined ground squirrel, Franklin's ground squirrel, prairie vole, meadow mouse, deer mouse, red fox, and coyote.

Transitional plant communities consisting of interspersed cropland, waterways, permanent pastures, ditch banks, roadsides, and brush fencecrows are the primary habitat of the least shrew, meadow jumping mouse, striped skunk, coyote, red fox, woodchuck, and cottontail rabbit. Typical birds of these edge communities are the indigo bunting, woodcock, mourning dove, brown thrasher, song sparrow, cowbird, field sparrow, and the bobwhite quail.

Controlling erosion and enhancing wetlands in the river basin will improve wildlife habitat. The plan practices will improve habitat by widening available nesting and brood rearing areas for birds, increasing food supply, improving water quality, and increasing escape cover for all species. The practices having the most effect on these needs are buffer strips, no-till, tree planting, timber stand improvement, restoring wetlands and addressing point source pollutants.

Pheasants nest in wetlands, as do other species. It has been stated that over 40% of Illinois' threatened and endangered species depend on wetlands (USFWS-Illinois Wetlands). A study in Iowa showed 37 quail nests every 247 acres in no-till versus only 4 per 247 acres in conventionally tilled fields.

Recreation

Fishing, canoeing, hunting, sightseeing, photography, biking, bird watching and environmental studies are major recreation activities in the basin.

Current and proposed river access points exist at Walker's Ford, Fox Ridge (2), Lake Charleston, Lanman's Slough, Ryan Bridge, Newton, Greenup and Lawrenceville. In addition, there are other private access points. There are four State Parks in the basin (Walnut Point, Fox Ridge, Red Hills, and Sam Parr).

Economic Costs/Funding Solutions

Landowners are concerned about the cost of implementing solutions to resource problems such as flooding, soil erosion and water quality. Without financial assistance, many treatment practices are not economical for the individual landowner to implement. Offsite benefits should be considered for overall economic justification.

Alternatives such as property tax credit, income tax credit and other "green ticket" proposals such as the Illinois Vegetative Filter Strip Bill that amends the property tax code, have been suggested. These alternatives are being researched by the planning committee.

Water Usage and Supply

The Embarras River is a source of water supply. Protecting the quality and quantity are important to the communities along the Embarras. Charleston draws one half of its water from the river through a side channel reservoir. Other towns and villages draw water from shallow and deep wells in the river bottom flood plain.

The latest Mattoon water supply study indicates that the water supply is sufficient. Projections for Charleston up to the year 2030 show that the current supply is adequate with low to moderate growth. However, if large growth occurs and a 50-year drought occurs, Charleston may need more water. In addition to the cities of Mattoon and Charleston, E-J Water (a rural water system) draws its water from along the Embarras River.

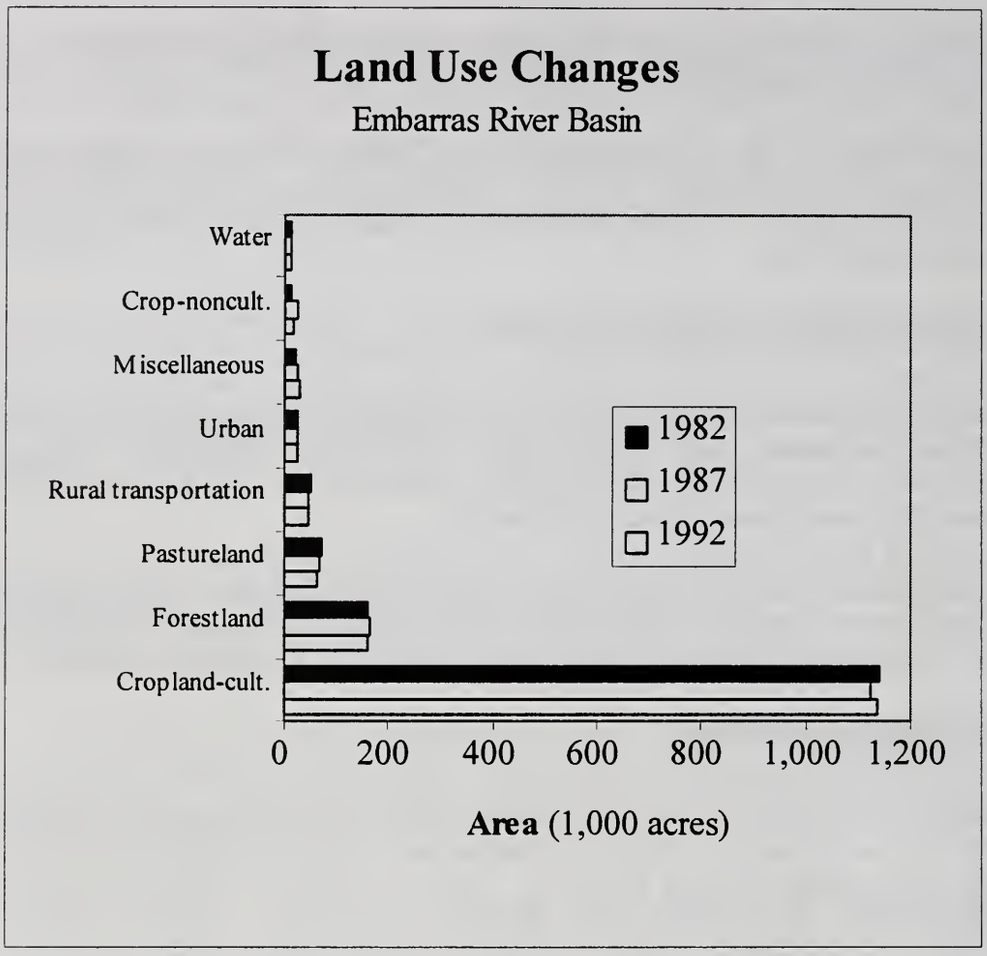
The quality of the surface water supply, although considered good, can easily be threatened by contamination from accidental chemical spills.

These issues need to be studied further and addressed by an interdisciplinary team of professionals and local citizens. This team can guide local officials to activities that protect the area's water resources.

Land Use Change

Land use has remained virtually unchanged from 1982 to 1992 as shown in the following graph.

Figure 9.



Small Bridge Outlets

The planning committee concerns included small bridge outlets. The 1976 Embarras River Basin Flood Control Study noted that 29 bridges over the Embarras River were included in the hydraulic model from the mouth of the Embarras upstream to the Coles-Cumberland county line. The March 1995 helicopter video included the Embarras and several tributaries. Approximately 59 bridges crossing the Embarras River have been seen on the video. The video includes the Embarras River from Villa Grove downstream to the Wabash River.

The table below shows the bridges noted on the video index for the tributaries (Vince Gutowski, 1995). This list represents approximately 25% to 50% of all the bridges on the tributary streams.

Table 9. Tributary Bridges

Stream	Number of Bridges Noted on Video Index
North Fork of the Embarras	5
Range Creek	6
Muddy Creek	5
Hurricane Creek	3
Whetstone Creek	1
Polecat Creek	2
Little Embarras River	7
Scattering Forks	4

The 1976 study also presented 21 minor channel improvements and seven major channel improvements. The minor channel improvements were primarily removal of logjams, drift accumulations, and sediment bars in the river. The major channel improvements related to three railroad bridges, three river cutoffs, and one sand-bar. Under current environmental considerations, the channel straightening (cutoffs) are not recommended, due to the impacts on the riparian ecosystems.

Two of the three railroad bridges noted on the 1976 study are still in use. One bridge is in Lawrenceville by the refinery and the other bridge is east of Newton. The remaining railroad bridge, at Greenup, has been abandoned.

Lawrenceville recently removed concrete piers of an abandoned railroad bridge (though this is **not** the bridge mentioned in the 1976 study). Details of their experience serves as a good case history of cooperation by local, state, and federal groups. Their work consisted of three phases:

1) Removing the logjam debris around the abandoned railroad bridge piers
2) Removing the steel railroad bridge
3) Removing the concrete bridge piers

The log jam against the abandoned railroad bridge piers was causing severe bank erosion, flooding upstream cropland, and threatening to expose a municipal water line serving the communities of Lawrenceville, Bridgeport, Sumner, and Petrolia. Local county, city, state and Federal officials, and local producers met to see what could be done to remove the log jam and raze the bridge piers. Congressman Glenn Poshard's aide was involved and updated through the entire process. Land ownership of the river beneath the bridge was never fully established. The new bridge owner did not respond to requests to remove the log jam.

NRCS provided Emergency Watershed Protection funds for the log jam removal. The Lawrence County SWCD acted as the local sponsor. Planning, started early in 1994, resulted in the log jam removal in August 1994. Lawrence County provided trucks and hauled part of the debris away to county property. Lawrenceville obtained the proper Corps of Engineers (COE) permits for placement of the majority of the logs and smaller debris.

After removing the log jam debris around the piers, the bridge owner took away the bridge steel in December 1994. While the river was low in February 1995, the Lawrenceville National Guard Unit removed the bridge piers. Two of the piers were then placed in the eroded north river bank. The Lawrence SWCD coordinated and facilitated this project. IDNR provided a machine and operator for a week. In addition, a local contractor donated a track hoe with jack hammer for one week. Lawrence County provided rock for an access road and fuel for the National Guard machinery. Lawrenceville provided funds to feed the National Guard members at a local restaurant and secured a COE permit for the placement of the pier material. Local producers also made a financial contribution to reimburse local expenses.

The eroded bank is filling back in and logs no longer accumulate at this point. To celebrate the project's successful completion in early spring of 1995, the Lawrence County Chamber of Commerce sponsored an official "river opening ceremony" for the local steering committee and others involved. A log draped with a ribbon was cut to officially "re-open" the river.

The ERMA directors, in conjunction with the Cumberland County Soil and Water Conservation District board, have asked the Illinois Department of Natural Resources (IDNR) to assist with the removal of the piers of the abandoned railroad in Greenup.

Lack of Education

Lack of education about the river basin, and stream channel dynamics were suggested as the reason that citizens take actions that were detrimental to the basin in general.

More opportunities for contact with resource planners and educators need to be made available so residents can gain the knowledge they need to effectively manage the basin resources.

OTHER PROBLEMS AND OPPORTUNITIES

Technical Advisory Committee and Institutional Concerns

In addition to the eighteen concerns identified by the local ERMA planning committee, there are other concerns that must be considered to ensure that regional and national concerns are addressed during planning. These concerns are:

Animal Resources - Livestock Waste Management
Threatened and Endangered Species
Cultural Resources
Natural Areas
Fisheries
Prime Farmland
Forestry
Civil Rights

It is important that any identified solutions to the local concerns do not negatively impact any of these concerns.

Animal Resources

Livestock operations are part of the agricultural activities in the basin. Illinois Census of Agriculture values for the number of livestock farms in each county are shown below. Statistics are not available for portions of each county in the basin, so county-wide values are used.

Table 10. Livestock Census Data

(1992 Census Of Agriculture)

County	Number Of Farms			
	Swine	Beef Cattle	Dairy Cattle	Sheep
Champaign	66	304	7	25
Clark	98	401	7	17
Coles	112	286	12	20
Crawford	77	293	10	16
Cumberland	125	311	30	8
Douglas	98	203	77	24
Edgar	111	505	6	28
Jasper	183	403	26	14
Lawrence	61	184	13	6
Richland	117	294	15	4

The primary effect of livestock operations within the basin will be on water quality when the animal waste is allowed to enter the river through the runoff water. This is not caused by all operations, only the ones that are not properly handling the waste produced. It is estimated that 81 more waste management systems are needed to reduce the nitrates, phosphates and other contaminants entering the river and its tributaries. These contaminants in the stream reduce water quality, increase the growth of aquatic vegetation, and can lead to reduced dissolved oxygen rates.

Threatened and Endangered Species

Threatened and endangered species information is included for the terrestrial, fresh water, and wetland habitats found in the river basin. The federal government as well as individual states, have identified endangered and threatened species. Federal Endangered Species are those in danger of extinction throughout all or a significant portion of its range. Federally Threatened Species are those which are likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range. State Endangered Species are those species which are in danger of extinction as a breeding species in Illinois. State Threatened Species include any breeding species which are likely to become a State Endangered Species within the forseeable future. The major cause of species decline is loss of habitat. Threatened and endangered species that may be found in the 10-county region of the Embarras River Basin are shown in the following table.

Table 11. Federal and State Threatened and Endangered Species List 10-County Region Embarras River Basin

SCIENTIFIC NAME	COMMON NAME	FEDERAL	STATE	HABITAT
Tomanthera auriculata	EARLEAF FOXGLOVE	C2	LT	prairie, savanna
Platanthera leucophaea	EASTERN PRAIRIE FINGED ORCHID	PHLT		prairie remnant
Ammodramus henslowii	HENSLOW'S SPARROW	C2	LE	prairie, wetland
Ixobrychus exilis	LEAST BITTERN		LE	wetland
Lanius ludovicianus	LOGGERHEAD SHRIKE	C2	LT	prairie, savanna
Asclepias meadii	MEAD'S MILKWEED	PHLT		prairie remnant
Circus cyaneus	NORTHERN HARRIER		LE	wetland, prairie, savanna
Podilymbus podiceps	PIED-BILLED GREBE		LT	wetland, aquatic
Lespedeza leptostachya	PRAIRIE BUSH-CLOVER	PHLT		prairie remnant
Buteo lineatus	RED-SHOULDERED HAWK		LE	forest, wetland
Elliptio dilatata	SPIKE		LT	aquatic
Bartramia longicauda	UPLAND SANDPIPER		LE	prairie
Gallinula chloropus	COMMON MOORHEN		LT	wetland, aquatic
Ptychobranchus fasciolaris	KIDNEYSHELL MUSSEL		LE	aquatic
Clouophis kirtlandii	KIRTLAND'S SNAKE	C2	LT	forest, wetland, aquatic, prairie
Villosa lienosa	LITTLE SPECTACLE CASE MUSSEL		LE	aquatic
Toxolasma lividus	PURPLE LILLIPUT MUSSEL	C2	LE	aquatic
Villosa iris	RAINBOW MUSSEL		LE	aquatic
Epioblasma triquetra	SNUFFBOX MUSSEL	C2	LE	aquatic
Veratrum woodii	FALSE HELLEBORE	C3	LT	forest
Lynx rufus	BOBCAT		LT	forest, savanna, primary
Orobanche ludoviciana	BROOMRAPE		LE	prairie, wetland
Etheostoma histrio	HARLEQUIN DARTER		LE	aquatic
Acalypha deamii	LARGE-SEEDED MERCURY		LT	forest, wetland
Calephelis matica	SWAMP METALMARK		LE	forest, wetland
Etheostoma pellucidum	EASTERN SAND DARTER	C2	LE	aquatic
Elliptio crassidens	ELEPHANT-EAR MUSSEL		LT	aquatic
Myotis sodalis	INDIANA BAT	PHLE	PHLE	forest, wetland, aquatic, cave
Lutra canadensis	RIVER OTTER		LE	forest, aquatic
Silene regia	ROYAL CATCHFLY	C3	LE	prairie, savanna
Crotalus horridus	TIMBER RATTLESNAKE		LT	primary, forest
Plethobasus cicatricosus	WHITE WARTY-BACK PEARLY MUSSEL	PHLE	PHLE	rivers
Carex prasina	DROOPING SEDGE		LE	forest, wetland
Fusconaia ebena	EBONYSHELL		LT	aquatic

Table 11. Federal and State Threatened and Endangered Species List (continued)

SCIENTIFIC NAME	COMMON NAME	FEDERAL	STATE	HABITAT
Hemidactylium scutatum	FOUR-TOED SALAMANDER		LT	aquatic, forest, wetland
Polygonum arifolium	HALBRED-LEAVED TEARTHUMB		LE	wetland
Asio otus	LONG-EARED OWL		LE	forest
Lycopodium clavatum	RUNNING PINE		LE	wetland, forest, primary
Plethobasus cyphyus	SHEEPNOSE MUSSEL		LE	aquatic
Hydrocotyle ranunculoides	WATER-PENNYWORT		LE	wetland, aquatic
Haliaeetus leucocephalus	BALD EAGLE	LT	LE	wintering
Tyto alba	COMMON BARN-OWL		LE	forest, prairie, savanna, wetland
Tympanuchus cupido	GREATER PRAIRIE-CHICKEN		LE	prairie
Rallus elegans	KING RAIL		LT	wetland, prairie
Quadrula cylindrica	RABBITSFOOT MUSSEL		LE	aquatic
Thamnophis sauritus sauritus	EASTERN RIBBON SNAKE			
Notrophis amblops	BIGEYE CHUB			

The above list of threatened and endangered species is from a November, 1995 query of the Illinois Natural Heritage Database. The Federal Status was modified to be consistent with the U.S. Fish and Wildlife Service listing for Illinois which was revised July, 1995. Since this information changes frequently, an updated list for specific projects should be obtained from the Illinois Endangered Species Protection Board and the U.S. Fish and Wildlife Service.

LE = Endangered
LT = Threatened,
C1, C2, C3 = Candidate Species,
E/SA = Endangered/Similarity of Appearance (all subspecies and hybrids)
PH = Species not recorded in this 10-county region but search for species wherever potential habitat is present.

Cultural Resources

The Embarras River has been a major water resource for the eastern part of Illinois since pre-settlement times. There is much evidence that the Embarras River area and its major tributaries were used extensively by historic and pre-historic cultures. The NRCS is committed to protecting cultural resource sites.

Since the basin covers such a large area, over 2,440 square miles, a specific cultural resources study has not been completed. Site specific cultural resource reviews will be completed before any land disturbing project is approved for implementation.

NRCS has cultural resource coordinators located throughout the basin who are trained in recognizing cultural resources. They will complete site reviews and coordinate with the State Cultural Resources Coordinator who is a professional archaeologist. NRCS will consult with the State Historic Preservation Officer and the Advisory Council on Historic Preservation, as appropriate, to complete inventories and evaluate any cultural resources that may be affected by conservation practices.

Natural Areas

Natural areas provide critical habitat for native Illinois plants, animals and natural communities. Through the Illinois Natural Heritage database, Natural Heritage Division of the Illinois Department of Natural Resources, information can be retrieved about inventoried sites that possess the biological diversity of Illinois' pre-settlement conditions. These ecosystems are important as living repositories for use in science, medicine, industry, and agriculture, as well as for future generation to develop their own sense of nature and reverence for the land. Appendix B lists the Illinois Natural Areas Inventory sites within the Embarras River Basin. This list includes the county name, the site name, the township/range/section and a brief description of the area (when available).

Fisheries

Fish communities in the Embarras typically include small minnows, shiners, and small sunfish. In areas where depth conditions are suitable, larger species can be found.

The Embarras River, particularly the reach between Charleston and Newton, has an excellent variety of aquatic habitats and extremely rich species diversity, making the middle section potentially one of the outstanding streams in Illinois. At least 92 species of fish have been reported for the basin including several that are rare or limited elsewhere in the state, including the harlequin darter, dusky darter, eastern sand darter, spotted bass, mountain madtom, and greenside darter. Three are endangered - the eastern sand darter, harlequin darter, and bigeye chub. The bigeye shiner found in the 1987 study is on the state threatened list. Only six species - steelcolor shiner (35%), redfin shiner (12%), bluntnose minnow (10%), bullhead minnow (9%), silverjaw minnow (6%), and larger sunfish (4%), made up 76% of all fish collected during the study.

The Index of Biotic Integrity (IBI) is used to evaluate stream ecosystems. It can help point out areas needing improvement.

IBI values rated 51.9% (420.7 miles out of 817) of the entire Embarras River system achieving full aquatic life use support, 43.3% as partial/minor use support, 4.8% as partial/moderate use support, and 0.6% (5 miles on Dogwood Creek by Oblong) as nonsupportive of aquatic life. Channelization, nonpoint agriculture runoff, oil field runoff, urban and oil field runoff along Indian Creek, and municipal wastewater treatment discharge coming into Hayes Branch and Dogwood Creek are considered factors keeping the entire basin from reaching full aquatic life use support (*IEPA Intensive Survey of the Embarras River Basin*, Ettinger, 1989).

The value of the sport fishing on the Embarras and its tributaries has been estimated by an IDNR fisheries biologist to be nearly $8,000,000 annually.

Prime Farmland

Prime Farmland is land that has the best combination of physical and chemical characteristics for producing food, feed, forage, fiber, and oilseed crops, and is also available for these uses. It has the soil quality, growing season, and moisture supply needed to economically produce sustained high yields of crops when treated and managed according to acceptable farming methods.

In general, Prime Farmland has an adequate and dependable water supply from precipitation or irrigation, a favorable temperature and growing season, acceptable acidity or alkalinity, acceptable salt and sodium content, and few or no rocks that interfere with tillage or rooting volume. It is permeable to water and air. It is not excessively erodible or saturated with water for a long period of time, and it does not flood frequently or it is protected from flooding by artificial means.

The majority of the soils in the Embarras River Basin are Prime Farmland. There are some soils that are naturally too wet to be adequately drained for farming or are on slopes that are too great to be safely farmed and protected from excessive erosion that meet the criteria of Additional Farmland of Statewide Importance. Generally, these soils are "nearly" Prime, and that economically will produce high yields of crops when treated and managed according to acceptable farming methods. Some may produce yields as high as Prime Farmland if conditions are favorable.

Approximately 75 percent of the soils in the Embarras River Basin (1,150,200 acres) meet the Prime Farmland criteria. This includes soils in the relatively flat upland sections and also many of the alluvial soils on the floodplains. It is assumed that most of the soils that need artificial drainage to be considered Prime have had those systems installed, as is the case in much of central Illinois. Floodplain soils must not flood more often than once every two years to be considered Prime. Beaucoup, Belknap, Darwin, and Wakeland soils are considered to be Prime Farmland where drained and either protected from flooding by levees or flooding does not occur during the growing season. Lawson soils are considered to be Prime Farmland where protected from flooding or flooding is less often than once in two years during the growing season. In general, the soils that are not Prime are those that are greater than 5 percent slope, too high in sodium, or are too wet to drain properly.

Forest Resources

Forests cover 11%, approximately 165,000 acres, of the Embarras River Basin. Although historically forests occurred throughout the basin, there was a predominance of prairie in the north portions and deciduous hardwood forest in the south portions of the basin. Substantial conversion of both cover types to agricultural uses has fragmented blocks of forest cover and narrow riparian forest strips along major drainage ways.

Forest Types are very general categories of forest cover named for the dominant tree species of each category. Much of the forest cover today in the Embarras River floodplain is the Elm-Ash-Soft Maple Forest Type, a forest cover type consisting of species of trees that grow in the moist and wet parts of the landscape. Another type occurring primarily on dry upland sites is the Oak-Hickory Forest Type. There are some areas of the basin supporting small amounts of the Maple-Beech Forest Type, which is natural and Pine Forest Type, which is planted.

Although forests comprise a significant portion of the landscape throughout the basin, forestry is not currently a significant economic factor. There is opportunity for forestry to play an increased economic role in the basin. Many of the benefits provided by trees to watersheds are best provided when the trees are in an immature stage of aggressive growth. There are numerous arguments for the harvest of trees at economic maturity, before growth stagnates and the regeneration of new trees occurs in their place. There are standards to follow to preserve and maintain wildlife habitats and to improve water quality while aggressively practicing forestry. Existing incentive programs can be packaged and promoted to accomplish forestry goals in the Embarras River Basin.

Civil Rights

All landowners and residents within the area are effected by the condition and treatment of the soil, water, air, plant and animal resources of the river basin. Small farms, female owners, and limited resource farmers deserve special considerations in the implementation of plan components. Technical and financial services will be provided to all landowners and operators on a non-discriminatory basis (see the USDA Civil Rights/Equal Opportunity Statement, inside the front cover). Delivery of services by USDA agencies to these groups is an important part of implementation of this plan. Services may be provided by: Natural Resources Conservation Service; Farm Service Agency; Cooperative Extension Service; Forest Service; Rural Development; Agricultural Research Service; and state and local government entities.

FORMULATION PROCESS

Summary of Alternatives Developed

Recommendations were developed at the fall 1995 Technical Advisory Committee meeting. These recommendations were presented and refined at the December and January ERMA directors meetings. For the purposes of the individual ERMA county meetings during January 1996, the list presented to the public included 6 alternatives:

(1) No Action
(2) Purchase 10% of the flooded cropland
(3) Build dams to control 30% of the Embarras River Basin
(4) Triple the amount of no-till cropland in the basin
(5) Identify and implement streambank stabilization measures
(6) Implement coordinated river basin planning in the Embarras River Basin.

No Action

Nothing would be done to address the locally-identified concerns in the basin. All existing problems would continue.

Purchase 10% of the flooded cropland

It is estimated that 150,000 acres of cropland in the basin receive flood damage. It was assumed that 10% of this cropland would be purchased for wetlands and riparian areas. This alternative would reduce cropland flooding and scour erosion; improve water quality, wildlife habitat, and natural character; and establish additional wetland areas.

Build dams to control 30% of the Embarras River Basin

Build 1,000 to 2,500 dry dams of sufficient size to control 30% of the drainage area of the entire Embarras River Basin. These small dams would be designed for control of a 3-inch rainfall. The dams could either have a small permanent pool or be dry dams. This alternative would reduce cropland flooding and sedimentation in the river system.

Triple the amount of no-till cropland in the basin

It is estimated that approximately one-quarter of the cropland acres in the basin is no-till. This alternative would convert an additional 500,000 acres (approximately 50%) of cropland to no-till. Therefore, the total no-till would be 75% of the cropland in the basin. This would result in reduced soil erosion and sedimentation; improved water quality and wildlife habitat; and a slightly reduced cropland flooding.

Identify and implement streambank stabilization measures

This alternative would identify channel meanders damaging cropland fields. After each site is identified, the measures would be designed and implemented to stabilize the streambank. This would result in reduced streambank erosion, improved water quality, and improved wildlife habitat (if vegetative measures are used).

Implement coordinated river basin planning in the Embarras River Basin.

This is a broad alternative and would include these efforts:

Promote and maintain the natural integrity of the Embarras
Implement natural resource conservation planning
Improve woodland management
Identify, stabilize, and restore wetlands
Identify and implement streambank stabilization
Create incentives for new practices

The following treatment options are included in the coordinated resource plan but were not completely studied because of time constraints. They will need further planning to implement.

Promote stormwater detention (rural and urban areas)
Increase monitoring stations (quantity and quality)
Minimize floodplain development
Complete rural septic inventory and educate the public
Clean up dump sites
Address point-source pollution
Address water use issues

Consultation and Public Participation

On April 23, 1993, six farmers met in a farm shop west of Greenup, Illinois to form an organization to seek solutions for problems in and around the Embarras River. In the spring of 1993, the Embarrass River Management Association (ERMA) was named and the initial formation process began. Over 200 people gathered April 6, 1994 at the Jasper County Courthouse to collectively voice their concerns. This meeting gave the incentive to start a river basin planning program.

ERMA is a private organization funded by its members. It is a grassroots structure with eight county steering committees consisting of a Chairman, Vice-Chairman, Secretary, and two local Directors. The Directors make up ERMA's governing Board of Directors. The first official Board of Directors meeting was held May 3, 1994 at the USDA building in Newton, IL. Officers were elected, organizational by-laws were adopted, and a logo for promotional purposes was approved.

ERMA requested NRCS to assess needs and concerns in the river basin. Public meetings were sponsored throughout the spring and summer of 1994. Resource concerns and problems were identified through public meetings in Jasper, Lawrence, Cumberland, Crawford, Richland and Coles counties. The ERMA Board of Directors met after these public input meetings and prioritized the identified resource concerns as follows:

1. Flooding
2. Log Jams/Obstructions
3. Water Quality
4. Erosion
5. Drainage
6. Beaver, Deer and Turkey related problems
7. Lack of Accountability-Communication
8. Loss of Natural Character
9. Private Property Rights
10. Sediment (sand deposits)
11. Bends in the Channel
12. Wetlands
13. Wildlife/Recreation Opportunities
14. Economic Costs (funding solutions)
15. Water Usage and Supply
16. Land Use Changes
17. Small Bridge Outlets
18. Lack of Education.

Four Technical Advisory Committees were established:

1. Flooding
2. Water Quality and Erosion
3. Wetland, Wildlife, Recreation and Natural Character
4. Information and Public Communication

These committees inventoried and evaluated the resource concerns in the Embarras River Basin. Agencies and groups represented on the technical advisory committee include the following:

USDA-Natural Resources Conservation Service
Illinois Department of Agriculture, Bureau of Soil and Water Conservation
Illinois State Water Survey
Illinois Department of Natural Resources
Illinois Environmental Protection Agency
Illinois Nature Preserves Commission
Illinois Department of Transportation
U.S. Geological Survey
Illinois State Geological Survey
Eastern Illinois University
Local Soil and Water Conservation Districts
U.S. Fish and Wildlife Service
Illinois Cooperative Extension Service
Illinois Riverwatch Network
Farm Bureau
City of Charleston

The technical advisory committee provided their reports and recommendations to the ERMA Board of Directors at their December 14, 1995 meeting. During January 1996, ERMA sponsored public meetings in Cumberland, Lawrence, Crawford, Richland, Jasper, Coles, Champaign and Douglas Counties. These meetings were held to review the following six alternatives.

1. Implement a coordinated watershed planning program
2. Increase acreage of no-till to 75% of cropland acres in the basin
3. Build dams to control runoff from 30% of basin
4. Implement streambank stabilization on eroding channel banks
5. Purchase 10% of flooded cropland and convert to non-cropland
6. No action

The meetings allowed an opportunity for public input into the proposed solutions to the resource problems.

Table 12 is the ERMA Alternatives Priority Summary. See Appendix A for public input comments from local ERMA meetings held in January 1996.

Through the public participation process, county ERMA groups selected the coordinated resource planning program as their approach to resource management within the river basin.

On March 6, 1996, a meeting was held with ERMA Directors, Technical Advisory Committee members, and interagency personnel to review the draft Embarras River Resource Management Plan. Comments have been incorporated into this final version of the plan.

Future Public Participation

The Embarras River Management Association (ERMA) continues its commitment to promote the improvements within the river basin with the same enthusiasm it has shown throughout its first years. ERMA plans to promote the River Basin Resource Management Plan by using the ideas listed below:

Each steering committee will hold public educational meetings in their county to inform landowners and farmers about the River Basin Resource Management Plan.

A series of newspaper articles discussing the Plan will be published in the 28 newspapers within the basin.

The aerial video produced by NRCS will be made available to schools and civic groups.

The video now under production by NRCS on watershed planning and ERMA's efforts to help the basin will also be shown to schools, civic groups, and farm organizations.

Directors of ERMA will be speaking at civic groups and farm organizations meetings to explain the Plan.

Local television and radio farm shows will be used to promote ERMA and the River Basin Resource Management Plan.

Information on the Plan will be made available to Eastern Illinois University, University of Illinois, and the community colleges within the basin. This would include showing the videos and slides.

Table 12. ERMA Alternatives Priority Summary
February, 1996

County	Watershed planning program	Increase no-till to 75% cropland	Dams on 30% of basin	Streambank stabilization	Purchase 10% of Cropland	No Action	Number of Responses
Champaign/ Douglas	1	2	3	4	5	6	28
Coles	1	2	3.5	5	3.5	6	12
Crawford	1	4	3	2	5	6	6
Cumberland	1.5	4	1.5	3	5	6	17
Jasper	1	3.5	3.5	2	5	6	25
Lawrence	3	2	1	4	5	6	6
Richland	3	1	4	2	5	6	25
AVERAGE PRIORITY	**1.6**	**2.6**	**2.8**	**3.1**	**4.8**	**6.0**	

NOTE: Priority rankings are summary data from each county meeting.
Number 1 indicates **highest** priority and number 6 indicates **lowest** priority.
Clark and Edgar Counties did not conduct meetings.

Description of Plan Components

The planned treatment components can be grouped into four general categories:

- Conservation Land Treatment for Erosion and Sediment Reduction
- Water Quality Improvement
- Wetland, Wildlife, Threatened and Endangered Species
- Flood Damage Reduction

This grouping is somewhat arbitrary. For example, Conservation Cover could be placed into the any one of three categories: Conservation Land Treatment for Erosion and Sediment Reduction; Water Quality Improvement; or Wetland, Wildlife, Threatened and Endangered Species. For the purposes of this plan, Conservation Cover was placed in Conservation Land Treatment for Erosion and Sediment Reduction.

Conservation Land Treatment for Erosion and Sediment Reduction

Clearing and Snagging
Conservation Cover
Contour Farming
Cover and Green Manure
Critical Area Planting
Diversions
Grade Stabilization Structures
Grassed Waterways
Mulch Tillage
No-Till
Pasture/Hayland Management
Pasture/Hayland Planting
Ponds
Terraces
Water & Sediment Control Basins (WASCOB)

Land treatment in the Embarras River Basin will be installed to reduce sheet and rill erosion, trap sediment, improve water quality, and provide habitat for fish, fowl, and other wildlife. This plan provides improved recreational areas for hunting and fishing.

Water Quality Improvement

Agricultural Waste Management System
Critical Area Planting on Oil Brine Damaged Land
Filter Strips
Nutrient Management
Pesticide Management
Streambank Stabilization and Protection
Water Table Management Research Project

This plan provides for a water level management research project. This project is located in Champaign County to study how to manage tile drainage systems to increase infiltration, decrease runoff and control flooding. This is the only research project contained in the plan.

Wetland, Wildlife, Threatened and Endangered Species

Field Border Strips
Riparian Easements
Time-Share Wetlands
Tree Planting
Wetland Establishment
Wildlife Habitat
Windbreaks
Woodland Management

"Time-share" wetland establishment on 14,440 acres (Wildlife wetland habitat management) is designed to convert pothole areas of tile-drained, row crop fields to temporarily flooded wetlands. This practice is called "Time-Share Wetlands" because the area will be drained during the growing season, then flooded after the crops are harvested. A valve will have to be installed on the tile drainage system to allow the farmer to drain or flood the pothole. These areas will improve water quality through nitrate reduction. During the winter and early spring period of temporary flooding some benefit may accrue to wildlife. Full-time wetland establishment will be implemented on 660 acres.

Flood Damage Reduction Features

Dry dam structures to slow storm water runoff and reduce flooding impacts

It is important to note the difference between two terms used in this report: dams and ponds. The ERMA planning committee originally formulated the alternative of a multitude of upland dams distributed throughout the basin. During the planning process, these dams were considered to be in the 200 - 500 acre drainage area size. These dams will have flood control benefit. Cumberland and Clark County each have over 100 potential sites for dams of this size. These dry dams have only a temporary pool of water, approximately 10 to 15 acres. The number of dams needed includes the anticipated effects on runoff after the adoption of other plan components such as: land treatment for erosion and sediment reduction and wetland, wildlife, threatened and endangered species measures.

As NRCS employees determined the need for conservation measures within individual counties, it was determined that a need for dams of smaller size existed. These dams, each having a drainage area smaller than 200 acres in size, are called ponds. The flood control benefits of these ponds would be very localized. Clark, Crawford, and Lawrence Counties each have over 250 potential sites for ponds. These ponds would have a pool size of approximately 5 acres.

The dams will have earthfill embankments with a principal spillway pipe through it. Each structure will also have an earth vegetated emergency spillway. The dams will likely need to meet IDNR-OWR dam safety permitting criteria. These structures are most likely to be of the size Class III small. Therefore, the 25-year storm (approximately 5.4 inches) will be detained in the dam without flow in the emergency spillway. The flow depth of the emergency spillway will be determined using the 100-year storm (approximately 7.4 inches).

This criterion exceeds the goal expressed by the ERMA planning committee of controlling a 3-inch rainfall (2-year frequency). By using IDNR's permit criteria, additional flood control is realized at the medium frequency (25-year) storms as well as the more frequent storms (2-year).

These upland dry dams essentially replace the storage function of upland wetlands that formerly stored large volumes of water on the uplands and released it slowly to the stream systems. However, these dams will not replace the biological function of upland wetlands.

The following considerations will be utilized when siting dams and ponds to avoid or minimize environmental impacts. Wet-site tree species will be encouraged for planting in dry dam pools. Native grasses and forbs will be encouraged for grass plantings and alien cool season grasses will be discouraged. Breaks in the riparian forest corridors caused by construction of the dams will be replaced by tree plantings around the dam and up both sides of the pool. Siting will avoid high quality forest cover to enhance existing habitats, complement other habitats, and emulate natural systems whenever possible. In addition, the siting process will consider stream type (permanent or intermittent) and landscape position in order to avoid or minimize impacts on fish, mussels, and other aquatic organisms. See the Avoidance, Minimization, and Mitigation section for avoidance, minimization, and mitigation procedures for environmental impacts.

Technical Support

Assistance from field offices and staff specialists for planning and implementation will be available.

Avoidance, Minimization, and Mitigation

During the siting process of applying individual planned measures, these are the steps that will be followed in regard to environmental impacts.

1. Avoid any negative environmental impacts.

2. If it is not possible to completely avoid a negative environmental impact, then the negative impact will be minimized.

3. If a minimal negative impact is not possible, then the impact will be mitigated in consultation with appropriate federal, state, and local environmental agencies such as: US Fish and Wildlife Service and Illinois Department of Natural Resources.

The mitigation requirements for this project were developed through interagency consultation with divisions of the Illinois Department of Natural Resources, U.S. Forest Service, U.S. Fish & Wildlife Service, Illinois Department of Agriculture, and Illinois Nature Preserves Commission on March 6, 1996. All Illinois Natural Area Inventory (INAI) sites will be avoided during site planning and construction. Unavoidable impacts to natural areas will be minimized and mitigated in conformance with National Environmental Policy Act (NEPA) provisions.

The construction of dams may have an impact on native hardwoods, estimated to be around 3,400 acres, due to tree clearing for the construction sites. The following considerations will be utilized when siting dams and ponds to avoid or minimize environmental impacts. Wet-site tree species will be encouraged for planting in dry dam pools. Native grasses and forbs will be encouraged for grass plantings and alien cool season grasses will be discouraged. Breaks in the riparian forest corridors caused by construction of the dams will be replaced by plantings around the dam and up both sides of the pool. Siting will avoid high quality forest cover to enhance existing habitats, complement other habitats, and emulate natural systems whenever possible. In addition, the siting process will consider stream type (permanent or intermittent) and landscape position in order to avoid or minimize impacts on fish, mussels, and other aquatic organisms.

Permits and Compliance

Structural elements of the plan will require permits from U.S. Army Corps of Engineers; Illinois Department of Natural Resources-Office of Water Resources; and Illinois Environmental Protection Agency. Other state and local permits may be required. Other federal statutes with which the plan will comply are listed in the following table.

Table 13. Water Resources Council-Designated Environmental Statutes

Federal Statute	
Analysis of Impacts of Prime & Unique Farmland	CEQ Memorandum; August 11, 1980
Archaeological and Historic Preservation Act	16 U.S.C 469 et seq.
Clean Air Act, as amended	42 U.S.C. 1857h-7 et seq.
Clean Water Act	(Federal Water Pollution Control Act)
Coastal Zone Management Act	U.S.C. 1451 et seq.
Farmland Protection Act	
Federal Water Project Recreation Act	16 U.S.C. 460-1(12) et seq.
Fish & Wildlife Coordination Act	16 U.S.C. 661 et seq.
Flood Plain Management	Executive Order 11988
Land and Water Conservation Fund Act	16 U.S.C. 460/460/-11, et seq.
Marine Protection, Research and Sanctuary Act	33 U.S.C. 1401 et seq.
National Environmental Policy Act	42 U.S.C. 4321 et seq.
National Historic Preservation Act	16 U.S.C. 470a et seq.
Protection of Wetlands	Executive Order 11900
Rivers and Harbors Act	33 U.S.C. 403 et seq.
Watershed Protection and Flood Prevention Act	16 U.S.C. 1001 et seq.
Wild and Scenic Rivers Act	16 U.S.C. 1271 et seq.

Total Resource Needs

Table 14 shows the total resource needs for the Embarras River Basin. These total resource needs were estimated by local NRCS staff utilizing the following information:

IDNR "T by 2,000" transect data
USDA-NRCS National Resource Inventories
Local resource planning efforts
Onsite investigations
County treatment trends
Previous implementation trends

Table 14. Embarras River Basin Total Resource Needs

Practice/Systems	Units	Cham-paign	Clark	Coles	Crawford	Cumber-land	Douglas	Edgar	Jasper	Lawrence	Richland	TOTAL
CONSERVATION LAND TREATMENT FOR EROSION AND SEDIMENTATION												
Clearing and Snagging	Feet	40,000	15,000		27,000	6,600			10,000		10,000	108,600
Conservation Cover	Acres		3,500	1,000	25,000	2,000	950	4,000	3,300	5,000	500	45,250
Contour Farming	Acres		2,000		11,000							13,000
Cover and Green Manure	Acres		600		2,000	1,500			1,500	1,200	550	7,350
Critical Area Planting	Acres		40		1,000	100			263			1,403
Diversions	Feet		35,000	5,000	3,000	10,000	7,000	20,000				80,000
Grade Stabilization Structures	No.	20	420	150	512	150	50	70	214	250	32	1,868
Grassed Waterways	Acres	500	620	250	309	300	300	130	526		38	2,973
Mulch Tillage	Acres		17,000	50,000	21,000	20,000			46,000		1,500	155,500
No-Till	Acres	30,000	9,000	50,000	21,000	20,000	30,600	10,000	50,000	10,000	3,500	234,100
Pasture/Hayland Management	Acres		2,200	5,000	3,500	2,000	325					13,025
Pasture/Hayland Planting	Acres		150	5,000	600	200	325	2,000	2,500			10,775
Ponds	No.		350	50	521	50	12	36	75	250	25	1,369
Terraces	Feet		120,000	450,000	80,000	25,000	24,000	10,000	60,000	145,200	16,000	930,200
Water & Sediment Control Basins (WASCOB)	No.	20	400	50	480	200	22	50	200	500	100	2,022
FLOOD DAMAGE REDUCTION												
Dams	No.		129	60	81	312	17	22	34	12	5	672

Table 14. Embarras River Basin Total Resource Needs

Practice/Systems	Units	Cham-paign	Clark	Coles	Crawford	Cumber-land	Douglas	Edgar	Jasper	Lawrence	Richland	*TOTAL*
WATER QUALITY												
Agricultural Waste Management System	No.		10	7	15	20	5	4	20			81
Critical Area Planting - Oil Brine	Acres		60		2,100				356	675		3,191
Filter Strips	Acres	500	85	500	25	600	100	200	128	15	8	2,161
Nutrient Management	Acres	60,000	95,000	150,000	63,000	140,000	30,600	80,000	50,000	60,000	7,600	736,200
Pesticide Management	Acres	60,000	95,000	150,000	63,000	140,000	30,600	80,000	50,000	60,000	7,600	736,200
Streambank Stabilization and Protection	Feet		11,000	82,000	9,200	100,000	45,460	12,000	32,000	10,000	3,000	304,660
Water Table Management Research Project	Each	1										1
WETLANDS, WILDLIFE, AND THREATENED & ENDANGERED SPECIES												
Field Border Strips	Feet		45,000			75,000	22,600		15,000		10,000	167,600
Riparian Easements	Acres	900								3,312		4,212
Time-Share Wetlands	Acres	1,000		5,000			3,000	10,000				19,000
Tree Planting	Acres	500	100	2,000	320	200						3,120
Wetland Establishment	Acres		20	500		50	300					870
Wildlife Habitat	Acres	200	150	50,000	564	500	250	200			250	52,114
Windbreaks	Feet		12,000		15,000	60,000			15,000			102,000
Woodland Management	Acres	500	9,000	20,000	2,560	10,000	400		4,250			46,710

Costs

This resource plan covers a broad range of issues and concerns, and also contains a broad list of conservation treatments to address these issues and concerns. For treatment costs see Table 15.

Category	Cost	(% of Total Resource Needs)	
		On-going Program	**Implementation Rate**
Conservation Land Treatment Practices	$34,000,000	5%	80%
Water Quality Improvement	$15,000,000	5%	80%
Wetland, Wildlife, Threatened and Endangered Species	$10,000,000	5%	80%
Flood Damage Reduction Features	$13,000,000	0%	100%
Technical Support	$ 5,000,000	-	-
Mitigation	$ 5,000,000	-	-
Total Estimated Cost	**$82,000,000**		

The estimated cost for land treatment for erosion and sediment reduction ($34,000,000), water quality improvement ($15,000,000) and wetland, wildlife, threatened and endangered species ($10,000,000) accounts for 80% anticipated acceptance and implementation rate. Flood damage reduction features ($13,000,000) accounts for 100% structure construction. Technical support ($5,000,000) accounts for planning, design and implementation assistance needed from field office and staff specialists. Mitigation ($5,000,000) accounts for replacement of forest and natural area values that may be disturbed or destroyed during construction of dry dams. See the Avoidance, Minimization, and Mitigation section for additional information about mitigation.

Table 14. Total Resource Needs quantities have been reduced by the following formula to arrive at *Table 15. Quantities and Cost by Practice* quantities. It should be noted that this plan is a voluntary plan.

$$\text{Quantity}_{\text{Table 15}} = \text{Quantity}_{\text{Table 14}} \times \frac{(100 - \text{On-going Program \%})}{100} \times \frac{(\text{Implementation Rate})}{100}$$

Example: No-till Acres

$$\text{Quantity}_{\text{Table 15}} = 234{,}100 \text{ acres} \times (0.95) \times (0.80)$$

$$\text{Quantity}_{\text{Table 15}} = 177{,}916 \text{ acres}$$

Table 15. Quantities & Cost by Practice

Practice	Unit	Unit Cost	Quantity	Total Cost
Clearing and Snagging	Feet	$5	82,536	$412,680
Conservation Cover	Acres	$199	34,390	$6,843,610
Contour Farming	Acres	$10	9,880	$98,800
Cover and Green Manure Crops	Acres	$20	5,586	$111,720
Critical Area Planting	Acres	$1,917	1,066	$2,043,522
Diversions	Feet	$4	60,800	$243,200
Grade Stabilization Structures	Number	$3,520	1,420	$4,998,400
Grass Waterway	Acres	$1,776	2,259	$4,011,984
Mulch Tillage	Acres	$0	118,180	$0
No-till	Acres	$0	177,916	$0
Pasture and Hayland Management	Acres	$100	9,899	$989,900
Pasture and Hayland Planting	Acres	$182	8,189	$1,490,398
Ponds	Number	$7,503	1,040	$7,803,120
Terraces	Feet	$3	706,952	$2,120,856
Water and Sediment Control Basins	Number	$1,500	1,537	$2,305,500
Conservation Land Treatment Subtotal				*$33,473,690*
Dams	Number	$20,000	672	$13,440,000
Flood Damage Reduction Subtotal				*$13,440,000*
Agricultural Waste Management Systems	Number	$19,855	62	$1,231,010
Critical Area Planting (Oil Brine)	Acres	$1,766	2,425	$4,282,550
Filter Strips	Acres	$275	1,642	$451,550
Nutrient Management	Acres	$5	559,512	$2,797,560
Pesticide Management	Acres	$5	559,512	$2,797,560
Streambank Stabilization and Protection	Feet	$15	231,542	$3,473,130
Water Table Management Study	Each	$80,000	1	$80,000
Water Quality Subtotal				*$15,113,360*
Field Border Strips	Feet	$0.08	127,376	$10,190
Riparian Easements	Acres	$1,478	3,201	$4,731,078
Time-share Wetlands	Acres	$90	14,440	$1,299,600
Tree Planting	Acres	$300	2,371	$711,300
Wetland Establishment	Acres	$120	661	$79,320
Wildlife Habitat Management	Acres	$26	39,607	$1,029,782
Windbreaks	Feet	$1	77,520	$77,520
Woodland Management	Acres	$55	35,500	$1,952,500
Wetland, Wildlife, and T&E Subtotal				*$9,891,290*
Total				**$71,918,340**

Description of Plan Effects

Flooding

The estimated flood reduction benefits of the resource plan are shown in the table below:

Item	Flood Reduction Benefits
Land Treatment for Erosion & Sediment, Water Quality Improvement, Wetland, Wildlife, T&E Practices	10%
Flood Damage Reduction Features	15%
Total	**25%**

Most of the potential sites for dams are located in the lower two-thirds of the basin, from Coles County south. The majority of flood control benefits will be close to the dams and on tributary streams. The effect will not be as great on the main stem of the Embarras.

Log Jams/Obstructions

The plan includes improved woodland management and streambank stabilization. These practices will improve flood plain and streambank conditions and significantly reduce conditions that contribute to log jams and obstruction formation. Clearing and snagging of logs and debris along 83,000 feet of the river and its tributaries is also included. If carried out under the direction of the interdisciplinary team, this will improve water flow throughout the river basin. However, removal of log jams and obstructions could be detrimental to certain aquatic species that require the conditions created by the log jams and obstructions. Clearing and snagging operations need to be carried out under the direction of an interdisciplinary team of responsible agencies and private individuals. Habitat availability and nutrient cycling will be considered.

Water Quality

The plan components significantly reduce sediment, chemicals, and nutrients that will be delivered to the river. Dams, streambank stabilization measures, no-till farming, filter strips, agricultural waste management systems, wetland establishment, and other land treatment systems in this alternative will have a major impact on nonpoint source runoff from agricultural areas such as row crops and livestock feed lots. District Conservationists in these counties identified the need for 736,200 acres of nutrient and pesticide management in the river basin. This management would specify application rates and timing, and will have a beneficial effect on water quality in Embarras River Basin.

Erosion

The proposed land treatment practices for erosion and sediment reduction will reduce sheet and rill erosion by 33% in the Embarras River Basin.

Drainage

Drainage ditch maintenance is the responsibility of the drainage district or private individual. Maintenance will comply with local, state, and federal regulations.

Resource plan activities should not have an adverse impact on cropland drainage. Alterations (e.g. to create wetlands) to a crop drainage system will be voluntary.

Beaver, Deer, and Turkey Related Problems

Practices in the plan that may lessen the effects of these damages are buffer zones, restoring wetlands, and timber stand improvement (favoring good mast producers such as oak, hickory, and walnut). Contact the Illinois Department of Natural Resources for advice and/or permission to remove or relocate animals that cause a problem.

Lack of Accountability/Communication

The formation of the Embarras River Management Association has significantly improved communication throughout the basin area through its representation from participating counties. The Association has provided many opportunities for communication throughout the planning process. Continued communication will be the key to the success of this resource plan.

Loss of Natural Character

The coordinated resource plan contains an element specifically dealing with promoting and protecting the natural integrity of the river system. Educational features along with conservation practices and structural measures are intended to promote and protect the natural character.

The planned practices will not adversely impact the scenic beauty and functions of any Illinois Natural Inventory sites or state parks within the basin.

Private Property Rights

This resource plan, other than establishing the criterion that resource treatment practices be implemented on a voluntary basis, does not have an impact on private property rights issues.

Sedimentation

If the proposed 672 dams and 1,040 ponds are built, approximately 25% of the Embarras River Basin will be sediment controlled thus improving water quality.

Bends in the Channel

Under current environmental considerations, the channel straightening (cutoffs) are not recommended due to the impacts on the riparian ecosystems.

Wetlands

Practices from the plan will protect wetlands from further siltation, which will prolong their existence. Restoring wetlands will slow stormwater runoff, filter excess nutrients from the runoff, recharge groundwater supplies, decrease flooding, and increase habitat for threatened and endangered species. In addition, the plan encourages wet prairie restoration in the lower part of the basin. Long-term ecological maintenance of newly-constructed wetlands or restorations should be performed by qualified individuals and be designed to benefit both the flora and fauna of the basin.

Wildlife Habitat

The plan practices will improve habitat by widening available nesting and brood rearing areas for birds, increasing food supply, improving water quality, and increasing escape cover for all species. The practices having the most effect on these needs are buffer strips, no-till, tree planting, timber stand improvement, restoring wetlands, and addressing point source pollutants.

Recreation

Improved water quality will encourage greater fish production. Controlling pollution, maintaining flow for longer periods, and stabilizing streambank erosion will improve canoeing experiences. An education program on river management, combined with a Clean-Up Day and increased access will improve the public's appreciation for the river.

Economic Costs/Funding Solutions

The implementation of this resource plan is dependent on receiving funding assistance from all available sources, state and federal government, public groups and private organizations.

Water Usage and Supply

This plan does not provide for increased water supply, but does provide for protection of the quality of water in the Embarras River Basin.

Land Use Change

This plan includes converting 19,000 acres of cropland to riparian wetlands, bottomland and upland woods, or buffer/filter strips. Construction of small dams may require changing a maximum of 3,400 non-contiguous acres from woodland to grassland that will need to be mitigated. Avoidance of high quality habitat will be high priority.

Small Bridge Outlets

This plan does not directly address the concern of small bridge outlets. The responsible parties for the bridges, such as counties or railroads, are the only ones who can physically change the openings.

The Embarras River Management Association links groups across county lines. This fosters the exchange of ideas in the basin. For example, the successful removal of the railroad bridge piers at Lawrenceville can be shared with the group at Greenup.

In addition, the helicopter video serves as a quick overview of the major streams in the basin. This video enables anyone to see which bridges act as an obstruction by catching debris and logs.

Lack of Education

The resource management plan has many features that relate to educational opportunities for landowners, producers and residents. Many opportunities will involve "hands-on" learning experiences that will teach the methods of resource management.

Animal Resources

The primary effect of livestock operations on the basin will be on water quality when the animal waste is allowed to enter the river through the runoff water. This is not caused by all operations, only the ones that are not properly handling the waste produced. District Conservationists estimate that 81 waste management systems could be installed to reduce the nitrates and other contaminants entering the river and its tributaries. These contaminants in the stream reduce water quality, increase the growth of aquatic vegetation, and reduce dissolved oxygen rates.

Threatened and Endangered Species

Care must be taken to avoid adverse impacts to threatened and endangered species. Plan items such as ponds, water and sediment control basins, terraces, no-till, etc., are likely to produce desirable effects with little or no adverse impacts to resources of concern. When structural sites have been identified, check with Illinois Department of Natural Resources, Endangered Species Protection Manager, and U.S. Fish & Wildlife Service for potential impacts.

Cultural Resources

Cultural resources within the basin area will be protected. Site specific projects will be reviewed as implementation proceeds. Cultural resource sites will be avoided or mitigated, as deemed appropriate by the NRCS and the State Historic Preservation Officer.

Natural Areas

The Illinois Department of Natural Resources, Natural Heritage Division, must be consulted in regards to land treatment that might impact any natural area site in the basin. Structural measures that will be installed must not impact natural areas during construction.

Fisheries

Components of this plan will improve water quality. Buffer zones next to the streams, terraces, no-till, tree plantings, restoring wetlands, stabilizing streambanks, grade stabilization structures, minimizing development in the floodplains, use of detention basins to store urban and rural surface runoff, and shallow water wetland areas will all reduce sediment into the river basin. This will reduce siltation of the streambed which is thought to be the major factor causing the 86% drop in number of mussels documented between 1956-1987. Addressing point source pollution, industrial-residential pollution, rural septic systems, restoring wetlands, implementing Integrated Pest Management (IPM) and nutrient management programs will reduce the amounts of pollutants entering the Embarras River and its tributaries. This may enable the river system to reach full life use support.

Prime Farmland

The practices that are included in this plan protect or enhance prime farmland characteristics. Implementation of conservation land treatment measures will have a minimal impact on prime farmland. Construction of the dams may have an adverse impact on prime farmland.

Forestry

This resource plan will improve forestry resources in the basin by the following five methods:

1. Agroforestry

This concept involves the use of trees in conjunction with other agricultural practices. Agroforestry practices may provide income through forest-based crops. It may save money as the least expensive solution to other problems such as snow control, streambank or floodplain stabilization, energy conservation or water quality. Agroforestry may enhance agriculture production and create opportunities for additional income by providing wildlife habitat or recreational opportunities.

2. Upland Hardwood Forest Protection And Management

Protection from domestic livestock use will increase the capability of upland forests to infiltrate, store, utilize, and slowly release precipitation. These areas provide opportunities for the diversion of surface water flow from other areas. Because hardwood forests can be managed to regenerate naturally, trees can be perpetually grown and harvested from these areas with cultural practices that seldom involve replanting.

3. Riparian And Floodplain Forest Protection And Management

Trees of all sizes play a role in stabilizing stream banks and flood plain soils. Strategically placed stands of trees can substantially reduce the energy and damaging effects of flood waters. Through measurements of the stream and the nature of the landscape through which it flows, a belt width can be calculated which will accommodate stream meandering within a relatively stable area secured by trees. These areas can be managed aggressively for wood crops or a particular wildlife habitat. These sites also support nut producing trees such as black walnut and pecan, which create excellent income opportunities. Aggressive management of these areas can provide a reasonable number of trees to the stream for aquatic habitats while reducing the overall number of trees contributing to debris piles and log jams. Healthy vigorous riparian corridors provide a place to slow and trap logs and debris when streams flood.

4. Tree Planting

There are areas converted from native forest cover to other uses that would be best served by restoring forest cover. Sometimes the only means of reestablishing tree cover is through planting. Wet soils, stream borders, steep slopes, over-grazed pastures, odd corners, and extremely small fields are some examples of land that is difficult to use with the rest of the farming operation or has become uneconomical to manage. Forestry options can restore profitability and economic opportunity to these areas.

5. Urban and Community Forestry

Attention to trees and tree-covered areas in residential areas can contribute to river basin health, improve quality of life and provide economic benefits.

Civil Rights

The implementation of this plan can have significant positive impacts on the economic and cultural diversity of this area by providing opportunities for minority, female and limited resource persons.

Resource Treatment Effects

The resource treatment effects by each practice in four categories are summarized in Tables 16-19. In the tables, a "+" indicates a positive impact, a "-" indicates a negative impact, and a "0" indicates no impact.

Grouping of the practices is somewhat arbitrary. For example, Conservation Cover could be placed into the any one of three categories: Conservation Land Treatment for Erosion and Sediment Reduction; Water Quality Improvement; or Wetland, Wildlife, Threatened and Endangered Species. For the purposes of this plan, Conservation Cover was placed in Conservation Land Treatment for Erosion and Sediment Reduction.

Table 16. Resource Treatment Effects
Land Treatment Practices for Erosion and Sediment Reduction Practices

Practice	Locally Identified Resource Concerns								
	Flooding	Log Jams & Obstructions	Water Quality	Erosion	Drainage	Beaver Deer & Turkey Problems	Lack of Account. & Commun.	Loss of Natural Character	Private Property Rights
Clearing & Snagging	+	+	0	+	0	0	0	-	0
Conservation Cover	+	+	+	+	0	+	0	+	0
Contour Farming	+	0	+	+	+	+	0	+	0
Cover & Green Manure Crops	+	0	+	+	+	+	0	+	0
Critical Area Planting	+	0	+	+	+	+	0	+	0
Diversions	+	0	+	+	+	+	0	+	0
Grade Stabilization Structures	+	0	+	+	+	+	0	+	0
Grassed Waterways	+	0	+	+	+	+	0	+	0
Mulch Tillage	+	0	+	+	+	0	0	+	0
No-till	+	0	+	+	+	0	0	+	0
Pasture & Hayland	+	0	+	+	+	+	0	+	0
Ponds	+	0	+	+	+	0	0	0	0
Terraces	+	0	+	+	+	0	0	+	0
WASCOB	+	0	+	+	+	0	0	+	0

+ Positive Effect
- Negative Effect
0 No Effect

Table 16. Resource Treatment Effects
Land Treatment Practices for Erosion and Sediment Reduction Practices

Practice	Locally Identified Resource Concerns								
	Sediment	Bends in Channel	Wetlands	Wildlife & Rec.	Economic Cost	Water Use & Supply	Land Use Change	Small Bridge Outlets	Lack of Education
Clearing & Snagging	+	+	-	-	-	0	0	0	+
Conservation Cover	+	0	+	+	+	+	-	0	+
Contour Farming	+	0	+	+	+	+	+	0	+
Cover & Green Manure Crops	+	0	+	+	-	+	+	0	+
Critical Area Planting	+	+	0	+	-	+	0	0	+
Diversions	+	+	0	+	-	+	0	0	+
Grade Stabilization Structures	+	+	+	+	-	+	0	0	+
Grassed Waterways	+	0	+	+	-	+	-	0	+
Mulch Tillage	+	0	+	+	+	+	0	0	+
No-till	+	0	+	+	+	+	0	0	+
Pasture & Hayland	+	0	+	+	-	+	-	0	+
Ponds	+	0	+	+	-	+	-	0	+
Terraces	+	0	+	+	-	+	0	0	+
WASCOB	+	0	+	+	-	+	0	0	+

\+ Positive Effect
\- Negative Effect
0 No Effect

Table 17. Resource Treatment Effects
Water Quality Improvement Practices

Practice	Locally Identified Resource Concerns								
	Flooding	Log Jams & Obstructions	Water Quality	Erosion	Drainage	Beaver Deer & Turkey Problems	Lack of Account. & Commun.	Loss of Natural Character	Private Property Rights
Agric. Waste Mgt. System	0	0	+	0	0	0	0	+	0
Critical Area Planting - Oil Brine	0	0	+	+	0	+	0	0	0
Filter Strip	+	0	+	+	0	+	0	0	0
Nutrient Mgt.	0	0	+	+	+	0	0	0	0
Pest Mgt.	0	0	+	0	0	0	0	0	0
Streambank Stabiliz.	+	+	+	+	0	0	0	-	0
Water Table Mgt. Study	+	0	+	0	+	+	0	+	0

+ Positive Effect
- Negative Effect
0 No Effect

Table 17. Resource Treatment Effects
Water Quality Improvement Practices

Practice	Locally Identified Resource Concerns								
	Sediment	Bends in Channel	Wetlands	Wildlife & Rec.	Economic Cost	Water Use & Supply	Land Use Change	Small Bridge Outlets	Lack of Education
Agric. Waste Mgt. System	0	0	+	+	-	0	0	0	+
Critical Area Planting - Oil Brine	+	0	+	+	-	+	0	0	+
Filter Strip	+	0	+	+	-	+	-	0	+
Nutrient Mgt.	+	0	+	+	+	+	0	0	+
Pest Mgt.	0	0	+	+	+	+	0	0	+
Streambank Stabiliz.	+	+	+	+	-	+	+	0	+
Water Table Mgt. Study	+	0	+	+	+	+	0	0	+

\+ Positive Effect
\- Negative Effect
0 No Effect

Table 18. Resource Treatment Effects
Wetland, Wildlife, Threatened and Endangered Species

Practice	Locally Identified Resource Concerns								
	Flooding	Log Jams & Obstructions	Water Quality	Erosion	Drainage	Beaver Deer & Turkey Problems	Lack of Account. & Commun.	Loss of Natural Character	Private Property Rights
Field Border Strips	+	+	+	+	0	+	0	+	0
Riparian Easements	+	+	+	+	0	+	0	+	0
Time-Share Wetlands	+	+	+	+	0	+	0	+	0
Tree Planting	+	0	+	+	0	+	0	+	0
Wetland Estab.	+	+	+	+	-	+	0	+	0
Wildlife Habitat Mgt.	+	+	+	+	+	+	0	+	0
Windbreaks	0	0	+	+	0	+	0	+	0
Woodland Mgt.	+	+	+	+	0	+	0	+	0

+ Positive Effect
- Negative Effect
0 No Effect

Table 18. Resource Treatment Effects
Wetland, Wildlife, Threatened and Endangered Species

Practice	Locally Identified Resource Concerns								
	Sediment	Bends in Channel	Wetlands	Wildlife & Rec.	Economic Cost	Water Use & Supply	Land Use Change	Small Bridge Outlets	Lack of Education
Field Border Strips	+	0	+	+	-	+	-	0	+
Riparian Easements	+	0	+	+	-	+	-	0	+
Time-Share Wetlands	+	0	+	+	-	+	0	0	+
Tree Planting	+	0	+	+	-	+	-	0	+
Wetland Estab.	+	0	+	+	-	+	-	0	+
Wildlife Habitat Mgt.	+	0	+	+	-	+	-	0	+
Windbreaks	+	0	0	+	-	0	-	0	+
Woodland Mgt.	+	0	+	+	-	+	0	0	+

\+ Positive Effect
\- Negative Effect
0 No Effect

Table 19. Resource Treatment Effects
Flood Damage Reduction Practices

Practice	Locally Identified Resource Concerns								
	Flooding	Log Jams & Obstructions	Water Quality	Erosion	Drainage	Beaver Deer & Turkey Problems	Lack of Account. & Commun.	Loss of Natural Character	Private Property Rights
Dams	+	0	+	0	0	+	0	-	0

Table 19. Resource Treatment Effects
Flood Damage Reduction Practices

Practice	Locally Identified Resource Concerns								
	Sediment	Bends in Channel	Wetlands	Wildlife & Rec.	Economic Cost	Water Use & Supply	Land Use Change	Small Bridge Outlets	Lack of Education
Dams	+	0	0	+	-	+	-	+	+

\+ Positive Effect
\- Negative Effect
0 No Effect

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APPENDIX A. Written Comments From Public Meetings

- Stress "education" as a key factor for success.
- Dams, filter strips, riprap & bendway weirs are good ideas, however, they need to be done on ALL creeks & ditches that flow into the Embarras River.
- Pinpoint one tributary in the watershed to use for an example of how the project will work.
- Incorporate aquaculture as an added incentive for building ponds.
- Install pipe outlets in main drainage ditches to slow the flow of runoff water.
- Need more awareness of problems among the upland farmers.
- Use woodland erosion control structures to slow runoff.
- Compile a neighbor-to-neighbor network on completed projects to make available to farmers.
- Use conservation tours and demonstration projects.
- Tax credits to get people involved money will get action.
- Communication and education to the public to get involvement and practices done.
- Alternatives given seem well-reasoned. Should complement each other and seem enough for now.
- Dam up the river.
- Buy 300-400 acres in bottoms and use as large retaining pond.
- Build a few small projects to show people how it helps, then take groups to show this on a tour. Need to do more than newspaper (articles) to get people's interest.
- Have the ERMA planning committee investigate or consider the potential of Conservation Credit initiatives as is being used in Wisconsin.
- Replace permanent easement of WRP (Wetland Reserve Program) to 15 years and give more priority points to the Embarras River Basin.
- Develop new modified crop alternatives suitable for large sediment retention basins (5-7 day storage).
- Create single or multi-county conservation district to direct/coordinate management and use or river/riparian resources.
- Long-term lease of cropland rather than purchase.

- Construct large ponds - combination of pond and dry dam capable of having large variations from water level to store water release into river. Would help to provide a more consistent water flow in river, better for fishing, boating, and quality.
- Controlling runoff with dams is likely to result in degraded wetlands.
- No-till, green buffers, restoration of woodlands by themselves ought to be enough to control runoff and reduce flooding efficiency.
- The Coordinated Watershed Planning Program alternative is good but building dams need not be part of this alternative to achieve better flood control.
- Plans that are developed should be voluntary and incentive driven.
- Landowners need to be made aware of the opportunities that can to derived through this program.
- "No Action" is NOT a viable option.
- Put an additional 500 head of cattle on every hillside; keep up the tradition!
- Need some cost-share incentive. Changes in tillage practices DO cost $$ for equipment. The tenant will bear all this cost.
- Real estate tax adjustments when projects are completed.
- Stop farmers from farming too close to ditches and streambanks
- Use of Jordan Slough and ditching to run flood water on east side of Villa Grove and back into Embarras River south of town.
- Set up annual maintenance on upper Embarrass to keep log jams cleared from river.
- County taxing bodies should be approached to give tax relief on acreage put into permanent filter strips, wetlands, grass buffers and reforestation.
- Use buffer strips along rivers & streams
- Increase no-till but with strict limitation on increased use of chemicals, i.e.. 1/3 of recommended rates by input suppliers.
- Alternate cover crops to increase soil fertility without fertilizer.
- Tax incentives for conservation tillage and highly erodible land.
- Long term set-aside acreage.
- Increase storage terraces.
- Increasing capacity of river by restoring the original depth plus streambank stabilization and no-till would help immensely.
- Do away with the worst areas of crooked river banks, dog legs, horseshoes, and switchbacks.

COUNTYNAME:.	SITENAME.....	TRS.ALL...	RATINGCOM.....
Lawrence	ALLISON DITCH	004N011W24	
Edgar	BABER WOODS	012N013W18	Baber Woods is an Illinois Nature Preserve. The area includes 44 acres of very high quality upland forest.
Coles	CENTER SCHOOL GEOLOGICAL AREA	011N010E15	A streambank on the West Branch of the Embarras River displays an outstanding section of the Sangamon Soil in the Center School Geological Area.
Lawrence	CENTERVILLE CEMETERY	004N011W25	
Lawrence	CHAUNCEY MARSH	005N012W19	Chauncey Marsh is a large, diverse area on the Embarras River. The natural area includes a high quality marsh.
Crawford		005N012W30	
		005N013W25	
		005N013W36	
Jasper	EMBARRAS RIVER	005N014W04	The Embarras River from Lake Charleston to the Jasper/Richland county line is a large natural stream 25 to 75 feet in width. The substrate consists of sand and gravel with some bedrock, cobble, and silt present. Stream habitats include extensive stretches of sand bottom, deep pools, abrupt bends, fast riffles, sandy and gravelly raceways, and sand bars. A high diversity of mussels is also present. The tree lined riparian zone ranging from zero to 50 feet gives way to row crop agriculture.
Cumberland		005N014W05	
Coles		005N014W08	
		005N014W16	
		005N014W17	
		005N014W21	
		006N014W30	
		006N014W31	
		006N014W32	
		006N014W33	
		006N011E07	
		006N011E18	
		006N011E19	
		006N010E01	
		006N010E02	
		006N010E04	
		006N010E05	
		006N010E06	
		006N010E08	
		006N010E09	
		006N010E10	
		006N010E11	
		006N010E12	
		007N010E31	
		006N009E01	
		007N009E02	
		007N009E03	
		007N009E10	
		007N009E11	
		007N009E14	
		007N009E22	

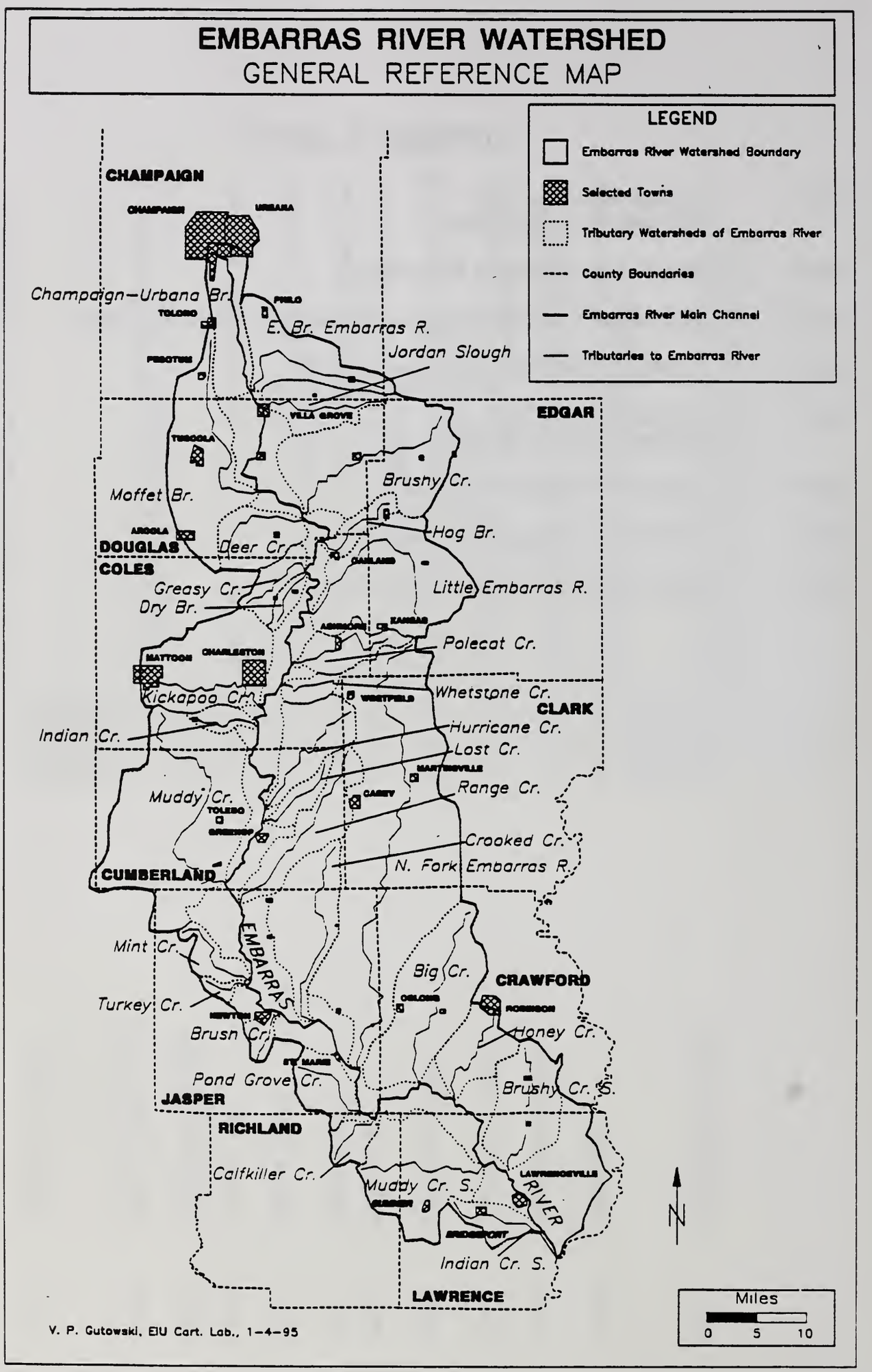
		007N009E23	
		007N009E25	
		007N009E36	
		008N009E03	
		008N009E04	
		008N009E10	
		008N009E15	
		008N009E21	
		008N009E22	
		008N009E27	
		008N009E28	
		008N009E34	
		009N009E02	
		009N009E03	
		009N009E10	
		009N009E16	
		009N009E20	
		009N009E21	
		009N009E28	
		009N009E29	
		009N009E30	
		009N009E31	
		009N009E32	
		010N009E01	
		010N009E02	
		010N009E11	
		010N009E12	
		010N009E13	
		010N009E14	
		010N009E23	
		010N009E24	
		010N009E25	
		010N009E26	
		010N009E35	
		010N010E06	
		010N010E07	
		011N009E01	
		011N009E02	
		011N009E11	
		011N009E13	
		011N009E14	
		011N009E22	
		011N009E23	
		011N009E26	
		011N009E27	
		011N009E34	
		011N009E35	
		012N009E25	
		012N009E26	
		012N009E35	
		012N009E36	
Douglas	EMBARRAS RIVER - CAMARGO	015N009E02	The Embarras River from U.S. Rt.36 to North of Charleston is a medium-sized natural stream 25 to 50 feet in width. The substrate consists of sand and gravel with some bedrock, cobble, and silt. A high diversity fo mussels are present. The tree lined riparian zone ranging from zero to 50 feet gives way to row crop agriculture.
Coles		015N009E03	

		015N009E04
		015N009E10
		015N009E11
		015N009E12
		015N009E13
		015N009E14
		015N010E18
		015N010E19
		015N010E20
		015N010E21
		015N010E28
		015N010E29
		015N010E33
		015N010E34
		015N010E35
		014N010E01
		014N010E02
		014N010E11
		014N010E12
		014N010E14
		014N010E15
		014N010E22
		014N010E23
		014N010E27
		014N010E28
		014N010E34
		014N010E35
		013N010E03
		013N010E09
		013N010E10
		013N010E15
		013N010E16
		013N010E20
		013N010E21
		013N010E29
		013N010E30
		013N010E31
		013N010E32
Coles	FIVE-MILE HILL PRAIRIE	011N009E01 Five-mile Hill Prairie is a very high quality prairie opening on a steep slope above the Embarras River.
Jasper	GRANDVILLE WOODS	008N014W34 Grandville Woods is a 67-acre forest in the bottomland of the North Fork of the Embarras River. The high and very high quality forest provides habitat for the endangered buckwheat vine Polygonum arifolium.
Clark	HAMMOND'S WOODS	011N013W07 Hammond's Woods includes three tracts of high to very high quality upland and bottomland forest, totaling 193 acres. This land, along the North Fork of the Embarras River and Doyles Creek, is protected in private ownership.
		011N014W12
Coles	HILLSIDE MARSH	012N010E04 The Hillside Marsh is a group of natural seepage areas on a tributary to the Embarras River. The seep has many unusual plants, including some that are far from their normal range, such as poison sumac.
Jasper	HUDDLESTON WOODS	008N010E13 Huddleston Woods is a 40-acre woodlot with high quality

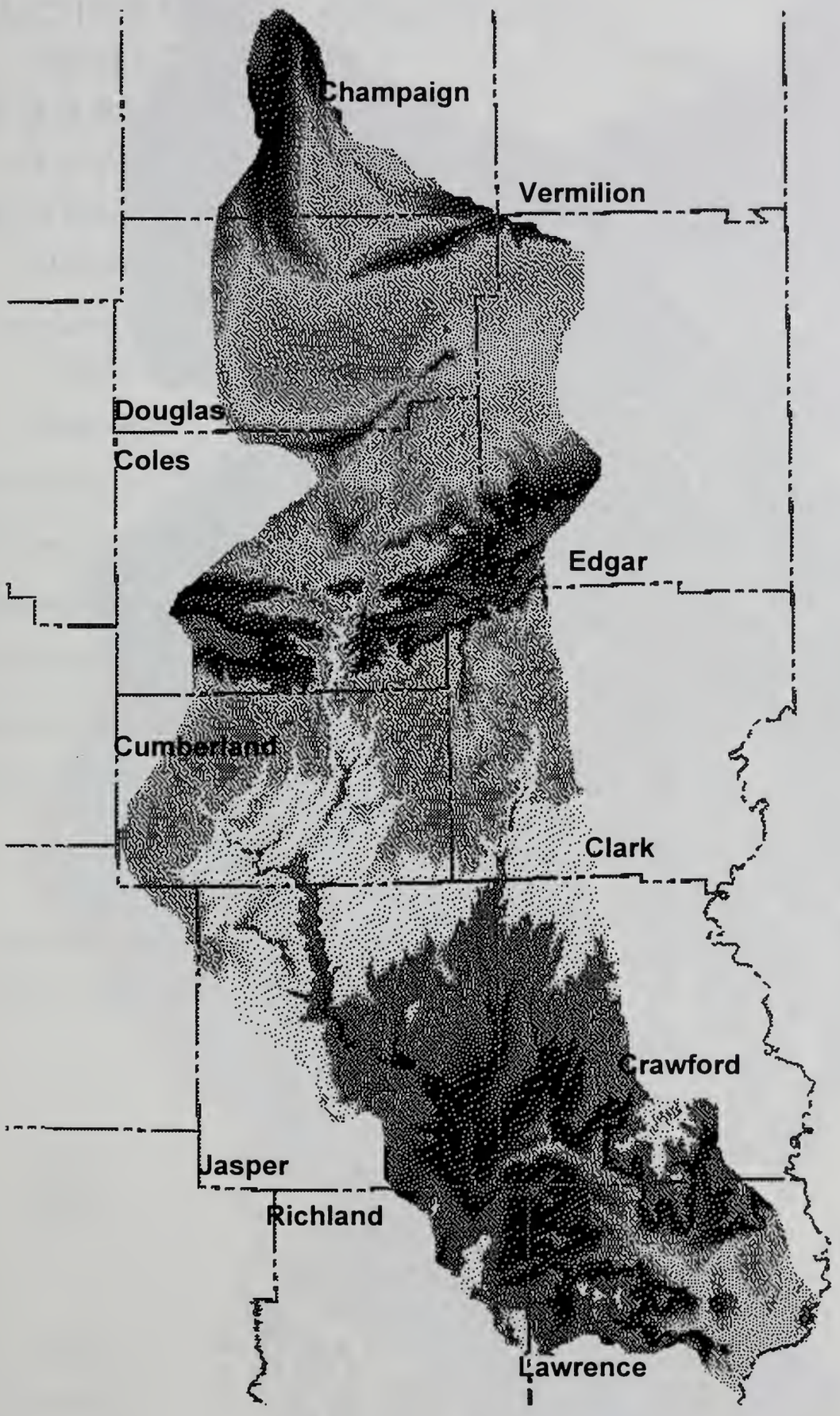
			upland forest.
Coles	HUTTON GEOLOGICAL AREA	011N010E22	A streambank in the Hutton Geological Area has an outstanding exposure of the Illinoian Till Plain formations.
Cumberland	JEWETT GEOLOGICAL AREA	009N009E31	A roadcut south of Jewett exposes an outstanding section of Illinoian and Kansan formations in this geological area.
Lawrence	LAWRENCEVILLE AIRPORT	004N011W22 004N011W23 004N011W26 004N011W27	
Douglas	MURDOCK RAILROAD PRAIRIE	016N010E36	The Baltimore and Ohio Railroad owns this only high quality railroad prairie in Douglas County.
Lawrence	RED HILLS SEEP SPRINGS	004N013W34	
Lawrence	RED HILLS WOODS	003N013W02	Red Hills Woods has a 26-acre area of high quality upland forest.
Clark	REDMAN'S FOREST	011N014W25	Redman's Forest is 23-acre, high quality forest on the banks of the North Fork of the Embarras River.
Coles	SARGENT'S WOODS	011N010E11	Sargent's Woods has 57 acres of high quality upland forest.
Jasper	STEBER'S WOODS	005N014W07	Steber's Woods is a 40-acre woodlot in the Embarras River bottomland with a high quality forest.
Coles	STEVENS HILL PRAIRIE	012N009E26	Stevens Hill Prairie is a very high quality hill prairie on a scenic overlook above the Embarras River.
Coles	STODDARD HILL PRAIRIE	012N010E06	Stoddard Hill Prairie is a very high quality prairie opening on the steep slope of a tributary to the Embarras River.
Lawrence	THACKER-PAULEY MARSH	005N013W33	The Thacker--Pauley Marsh is a very high quality marsh at the edge of the Slough in the Embarras River bottoms.
Douglas	WALNUT POINT	015N010E35 015N010E36 014N010E01 014N010E02	Walnut Point State Park has a large area of medium and high quality upland forest along the Embarras River.
Coles	WATER WORKS HILL PRAIRIE	012N009E24	The Water Works Hill Prairie is a very high quality prairie opening in a steep ravine leading to Lake Charleston.

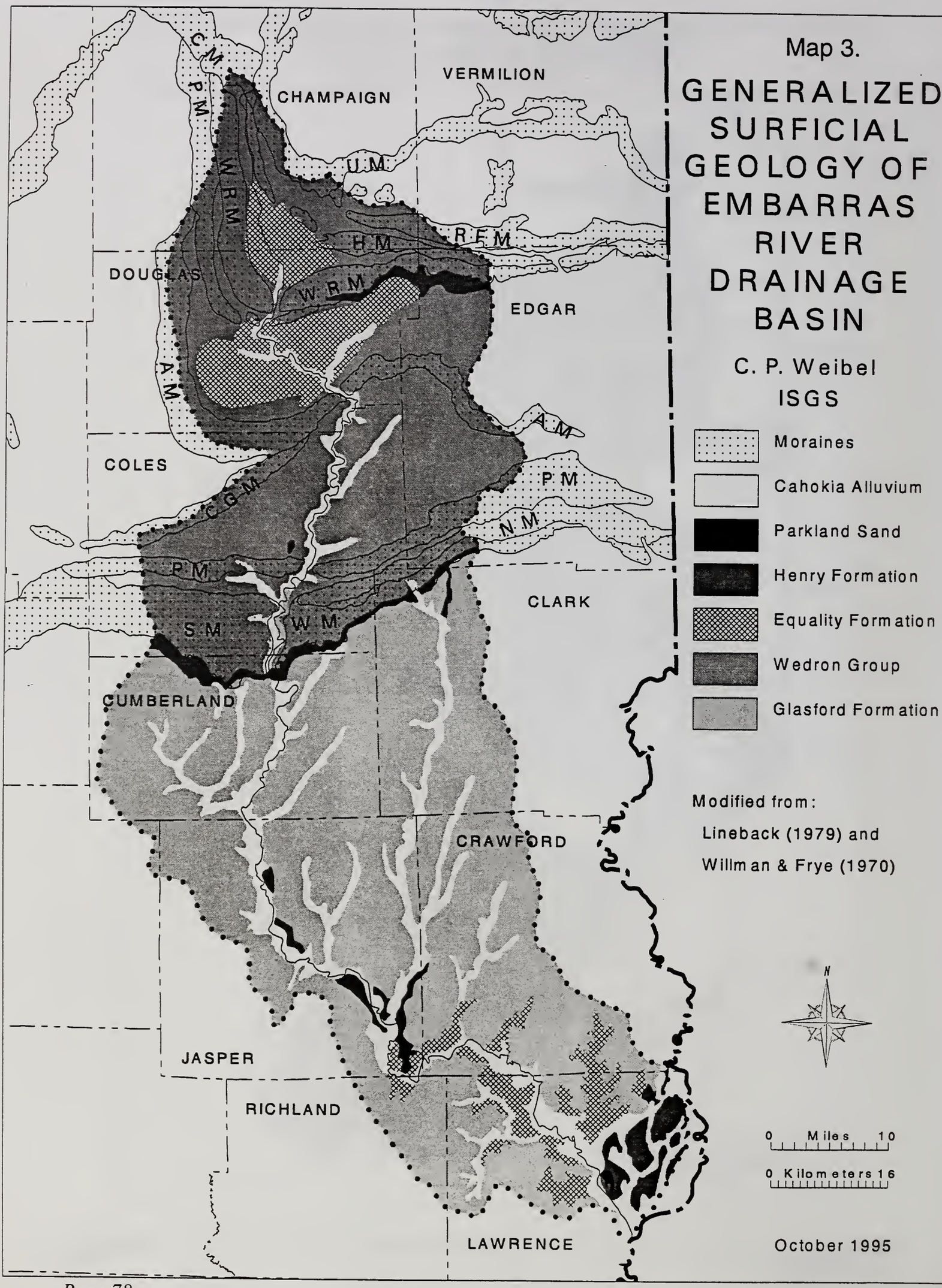
APPENDIX C. MAPS

Map 1.


EMBARRAS RIVER WATERSHED
GENERAL REFERENCE MAP
LEGEND
Embarras River Watershed Boundary
Selected Towns
Tributary Watersheds of Embarras River
County Boundaries
Embarras River Main Channel
Tributaries to Embarras River
CHAMPAIGN
CHAMPAIGN
URBANA
Champaign—Urbana Br.
PHILO
TOLONO
E. Br. Embarras R.
Jordan Slough
PESOTUM
VILLA GROVE
EDGAR
TUSCOLA
Brushy Cr.
Moffet Br.
ARCOLA
Hog Br.
DOUGLAS
Deer Cr.
OAKLAND
COLES
Greasy Cr.
Little Embarras R.
Dry Br.
ASHMORE
KANSAS
Polecat Cr.
MATTOON
CHARLESTON
Whetstone Cr.
Kickapoo Cr.
WESTFIELD
CLARK
Indian Cr.
Hurricane Cr.
Lost Cr.
MARTINSVILLE
Range Cr.
Muddy Cr.
CASEY
TOLEDO
GREENUP
Crooked Cr.
N. Fork Embarras R.
CUMBERLAND
EMBARRAS
Mint Cr.
Big Cr.
CRAWFORD
Turkey Cr.
OBLONG
ROBINSON
NEWTON
Brush Cr.
Honey Cr.
STE MARIE
Pond Grove Cr.
Brushy Cr. S.
JASPER
RICHLAND
Calfkiller Cr.
Muddy Cr. S.
LAWRENCEVILLE
RIVER
GILLESPIE
BRIDGEPORT
Indian Cr. S.
LAWRENCE
N
Miles
0 5 10
V. P. Gutowski, EIU Cart. Lab., 1-4-95

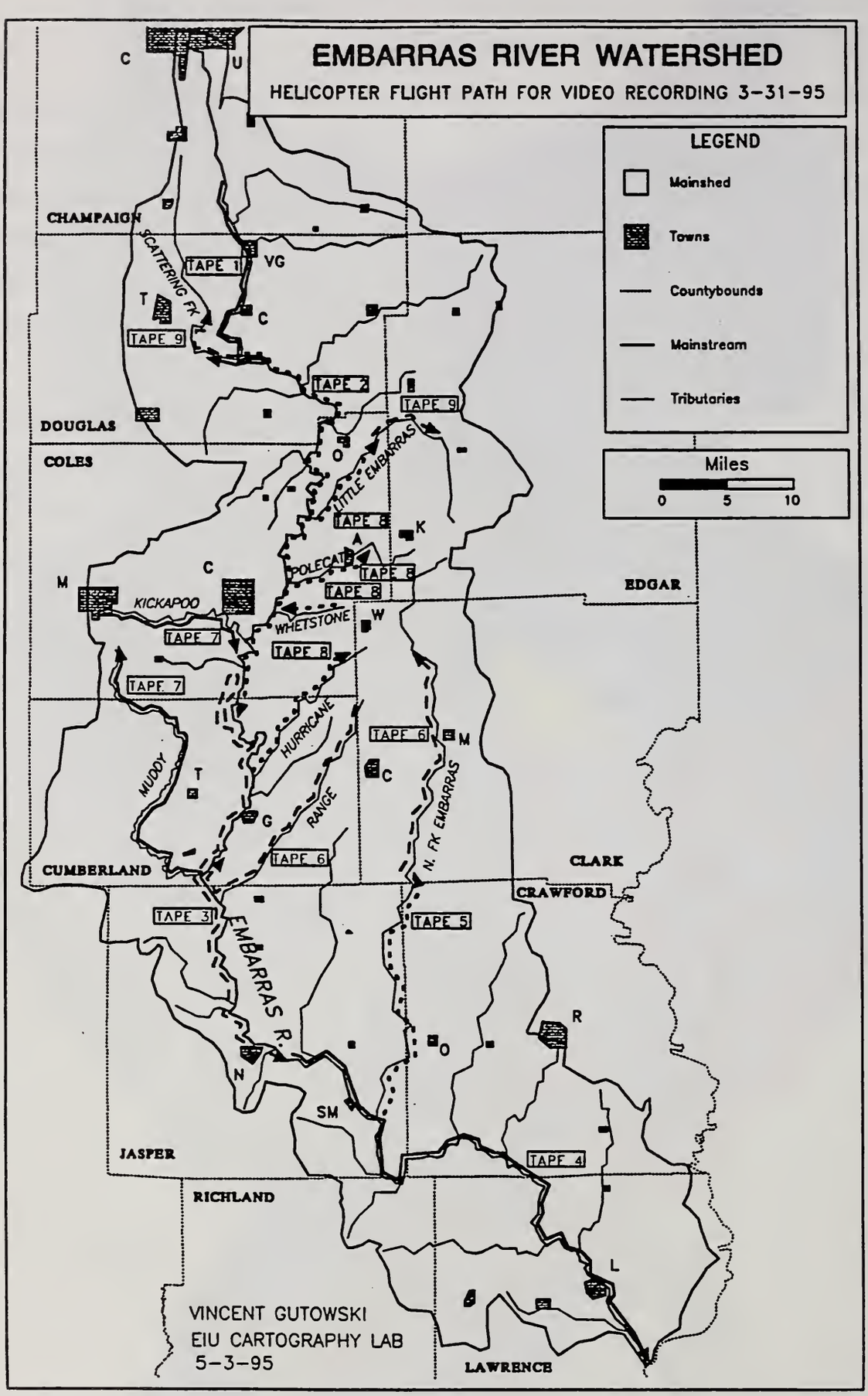
Map 2. Relief Map
Embarras River Basin



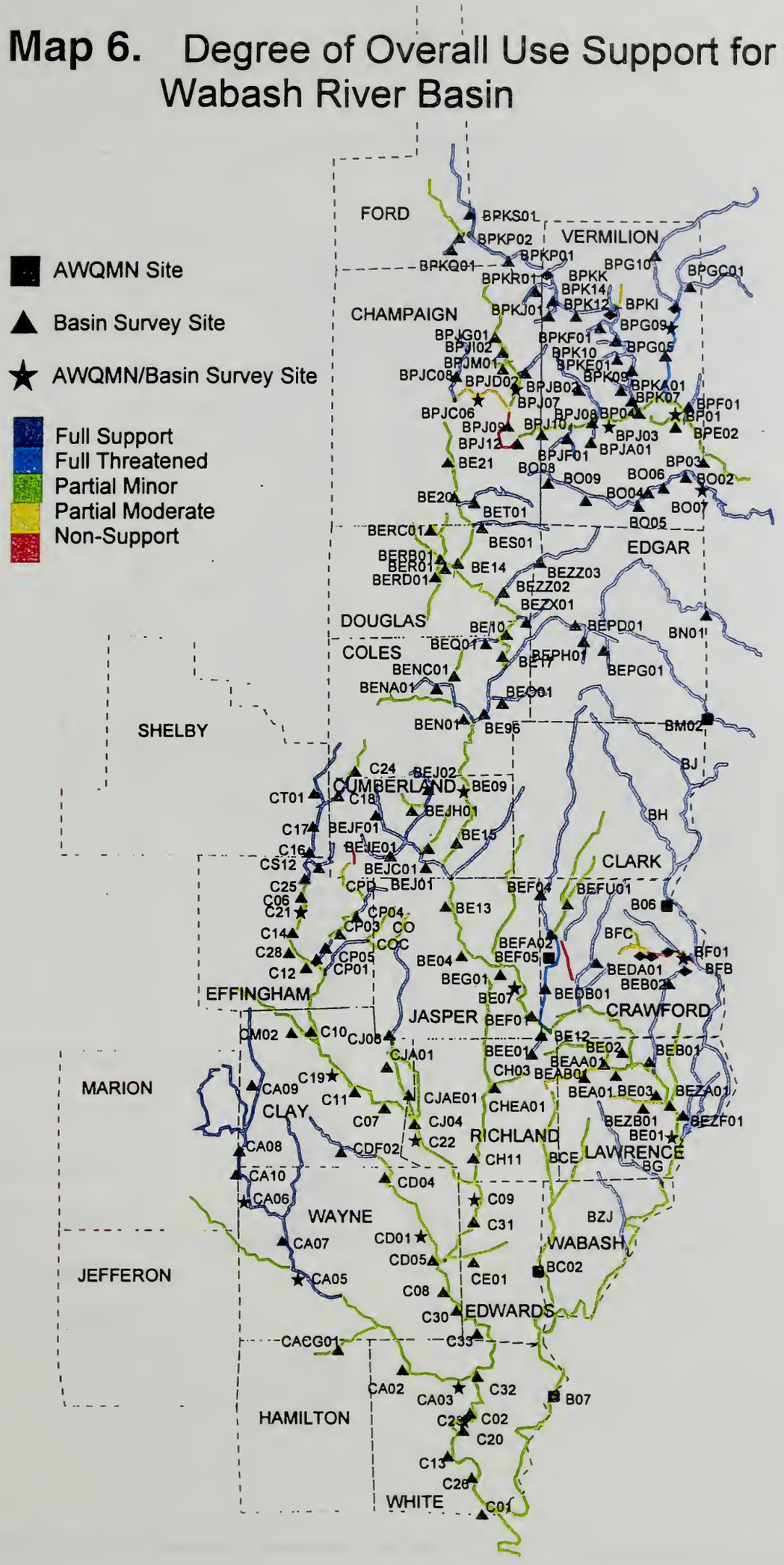

Map 3.
GENERALIZED SURFICIAL GEOLOGY OF EMBARRAS RIVER DRAINAGE BASIN
C. P. Weibel
ISGS
Moraines
Cahokia Alluvium
Parkland Sand
Henry Formation
Equality Formation
Wedron Group
Glasford Formation
Modified from:
Lineback (1979) and
Willman & Frye (1970)
VERMILION
CHAMPAIGN
DOUGLAS
EDGAR
COLES
CLARK
CUMBERLAND
CRAWFORD
JASPER
RICHLAND
LAWRENCE
CMPM
WRM
UM
HM
RFM
AM
CGM
PM
NM
SM
WM
N
0 Miles 10
0 Kilometers 16
October 1995

Map 4. Soil Association Map
Embarras River Basin

Map 5.


EMBARRAS RIVER WATERSHED
HELICOPTER FLIGHT PATH FOR VIDEO RECORDING 3-31-95
LEGEND
Mainshed
Towns
Countybounds
Mainstream
Tributaries
Miles
0 5 10
CHAMPAIGN
DOUGLAS
COLES
EDGAR
CLARK
CRAWFORD
CUMBERLAND
JASPER
RICHLAND
LAWRENCE
SCATTERING FK
LITTLE EMBARRAS
POLECAT
KICKAPOO
WHETSTONE
HURRICANE
MUDDY
RANGE
N. FK EMBARRAS
EMBARRAS R.
TAPE 1
TAPE 2
TAPE 3
TAPE 4
TAPE 5
TAPE 6
TAPE 7
TAPE 8
TAPE 9
VG
SM
VINCENT GUTOWSKI
EIU CARTOGRAPHY LAB
5-3-95

Map 6. Degree of Overall Use Support for the Wabash River Basin



Map 6.
Overall Use Support Legend

B	Wabash R.	BM	Sugar Cr.
BZJ	Crawfish Cr.	BN	Brouilletts Cr.
BC	Bonpas Cr.	BO	Little Vermilion R.
BCE	Little Bonpas Cr.	BP	Vermilion R.
BE	Embarras R.	BPE	Grape Cr.
BEA	Muddy Cr.	BPF	Stoney Cr.
BEAA	The Slough	BPG	N. Fk. Vermilion R.
BEAB	Paul Cr.	BPGC	Jordan Cr.
BEB	Brushy Cr.	BPJ	Salt Fk. Vermilion R.
BED	Big Cr.	BPJG	Upper Salt Fork
BEDA	Little Cr.	BPJA	Jordan Cr.
BEDB	Dogwood Cr.	BPJB	Stoney Cr
BEE	Calfkiller Cr.	BPJC	Saline Br.
BEF	N. Fk. Embarras R.	BPJD	Spoon Br.
BEFA	Willow Cr.	BPJF	Olive Branch
BEFU	Muddy Cr.	BPJI	Flatville Br.
BEG	Crooked Cr.	BPJM	Union Dr. Ditch
BEI	Range Cr.	BPK	Mid. Fk. Vermilion R.
BEJ	Muddy Cr.	BPKA	Glenburn Cr.
BEJC	Cottonwood Cr.	BPKE	Collison Br.
BEJE	Spring Point Cr.	BPKF	Knights Br.
BEJF	Mule Cr.	BPKI	Bluegrass Cr.
BEJH	Bear Cr.	BPKJ	Buck Cr.
BEN	Kickapoo Cr.	BPKK	Sugar Cr.
BENA	Riley Cr.	BPKP	Big Four Ditch
BENC	Cassel Cr.	BPKQ	Big Four Ditch trib.
BEO	Polecat Cr.	BPKR	Kerr Cr.
BEP	Little Embarras Cr.	BPKS	Wall Town Ditch
BEPD	Catfish Cr.	C	Little Wabash R.
BEPG	Drain Ditch #7	CZS	Blue Point Cr.
BEPH	Hickory Grove Cr.	CA	Skillet Fk.
BEQ	Greasy Cr.	CAGC	Auxier Ditch
BER	Scattering Fk.	CAN	Horse Cr.
BERB	Hackett Branch	CAR	Brush Cr.
BERC	Hayes Branch	CAW	Dums Cr.
BERD	Spoil Bank trib.	CAY	Lost Fk.
BES	Jordan Slough	CD	Elm R.
BET	E. Br. Embarras R.	CDF	Raccoon Cr.
BEZA	Beaver Pond Ditch	CE	Village Cr.
BEZB	Indian Cr.	CH	Fox R.
BEZF	Allison Ditch	CHEA	Big Cr.
BEZX	Hog Branch	CJ	Big Muddy Cr.
BEZZ	Brushy Fk.	CJA	Little Muddy Cr.
BF	Sugar Cr.	CM	Dismal Cr.
BFB	Lamotte Cr.	CO	Bishop Cr.
BFC	Robinson Cr.	COC	Dieterich Cr.
BFCB	Quail Cr.	CP	Salt Cr.
BG	Raccoon Cr.	CPD	Second Salt Cr.
BH	Mill Cr.	CS	Green Cr.
BJ	Big Cr.	CT	West Branch

Map 7.
Illinois Sediment Yield Rate Subareas